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SURVEY OF POTENTIAL RADIO FREQUENCY INTERFERENCE SOURCES.(U)
MAY 80 C D CRANDALL
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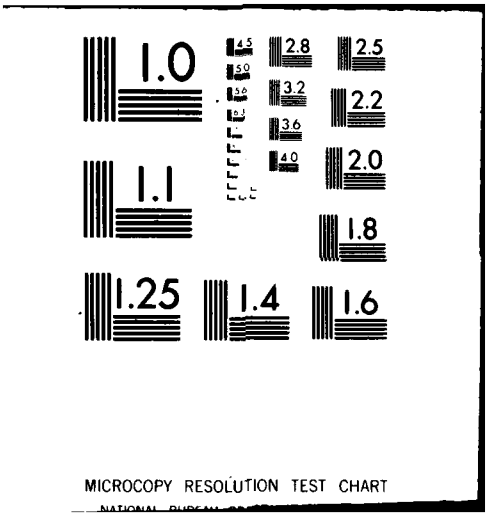
1 of 3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MICROCOPY RESOLUTION TEST CHART

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report is a survey of the potential Radio Frequency Interference (RFI) sources that are currently affecting the analysis of data from the SEASAT Scanning Multichannel Microwave Radiometer (SMMR) and those sources that could affect the design of the Large Antenna Multichannel Microwave Radiometer (LAMMR) for the National Oceanic Satellite System (NOSS). The SEASAT SMMR survey is limited to the 6.5 to 6.7 GHz channel and to emitters on the West Coast of the United States and Canada where RFI has been encountered. The NOSS LAMMR survey covers all of the potential

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20. Abstract (Continued)

frequencies of interest; 3.0 to 7.6 GHz, 10.5 to 11.0 GHz, 13.4 to 14.0 GHz, 14.5 to 14.7 GHz, 17.0 to 18.8 GHz, 20.8 to 22.4 GHz, 34.0 to 35.5 GHz, 36.0 to 37.0 GHz, 76.0 to 77.0 GHz, and 88.0 to 94.0 GHz. Also included are excerpts from the current international frequency allocation tables and excerpts from the U.S. position which was presented at the 1979 World Administration Radio Conference (WARC).

CONTENTS

SURVEY OF POTENTIAL RADIO FREQUENCY INTERFERENCE SOURCES

INTRODUCTION

This report is intended to provide information to technical managers for use in the planning of satellite-borne passive microwave radiometers. The need for this study was identified during a meeting of the National Oceanic Satellite System (NOSS) Sensor Working Group. Data from the SEASAT SMMR (Scanning Multichannel Microwave Radiometer) had revealed a possible problem in the West Coast United States/Gulf of Alaska area originating from the land-based emitters in the 6.5 to 6.7 GHz frequency range. Dr. V. Noble, Chairman of the NOSS Sensor Working Group, suggested that this study be performed as a first step in the identification of potential RFI (Radio Frequency Interference) sources. In addition to the RFI in 6.5 to 6.7 GHz, the NOSS Sensor Working Group directed that the study be expanded to include all of the potential NOSS-LAMMR (Large Antenna Multifrequency Microwave Radiometer) frequencies. Therefore this preliminary study effort addresses both the immediate SEASAT-SMMR RFI problem and the NOSS LAMMR planning issue.

The investigation began by contacting the Executive Office of the President, Office of Telecommunications Policy. They provided a copy of the "Tables of Frequency Allocations and Other Extracts from Manuals of Regulations and Procedures for Radio Frequency Management" January 1978 Edition, along with a copy of the Federal Communications Commission (FCC) Eighth Notice of Inquiry (NOI), May 5, 1978. These documents provided data on the present usage of the frequencies of interest as well as proposed changes that might be adopted at the 1979 World Administrative Radio Conference (WARC) held in Geneva. Appendix A contains excerpts from these documents. In addition contact was made with the Naval Intelligence Support Center (NISC) in Suitland, Maryland and the Defense Electromagnetic Compatibility Center (ECAC) in Annapolis, Maryland. Contact was also made with DoD and NASA representatives on the Interdepartmental Radio Advisory Committee (IRAC) and the National Telecommunications and Information Administration (NTIA).

The microwave frequencies of interest include the SEASAT frequencies 6.5 to 6.7 GHz mentioned above and the proposed LAMMR frequencies. The LAMMR frequencies that will actually be used will be selected from the proposed LAMMR frequencies. The LAMMR will most probably be a five-frequency, dual-polarization sensor which will be considered to be a 10-channel sensor. The proposed LAMMR frequencies will most

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likely fall within the folowing frequencies ranges/limits. These are: 3.0 to 7.6 GHz, 10.5 to 11.0 GHz, 13.4 to 14.0 GHz, 14.5 to 14.7 GHz, 17.0 to 18.8 GHz, 20.8 to 22.4 GHz, 34.0 to 35.5 GHz, 36.0 to 37.0 GHz, 76.0 to 77.0 GHz, 88.0 to 94.0 GHz.

SEASAT SMMR RFI PROBLEM

As mentioned above, RFI, has been observed in the SEASAT SMMR data. In particular the RFI problem was observed when the West Coast of the United States was in the field of view (FOV) of the SMMR antenna. Consideration of the geometry of the SMMR scan and antenna patterns along with the relatively high energy represented by a single microwave emitter, shows that it is possible that any shore based emitter might result in RFI. At the previously mentioned meeting of the NOSS Sensor Working Group, scientists from the National Aeronautics and Space Administration's Goddard Space Flight Center stated that the SEASAT SMMR RFI problem was observed when even satellite sub-satellite point was within 500 nautical miles of the coast. Therefore the ECAC data file was searched for all emitters in the 6.5 to 6.7 GHz frequency range that were within approximately 500 nautical miles of the West Coast of North America. The ECAC data file does not contain a terrain model, however it can sort by geographic limits (latitude, longitude). Also no SMMR data were processed when the sub-satellite point was over land. The geographic boundary used had a northern limit of 58°N latitude and a southern limit of 15°N latitude, the western and eastern limits used were lines from 140°W, 58°N to 110°W, 15°N in the west and 125°W, 58°N to 95°W, 15°N in the east. See Figures 1 and 2.

The results of this search of the ECAC data base were as follows:

3094	unclassified emitters located
4	CONFIDENTIAL emitters located
9	SECRET emitters located
3107	total emitters in area

The 3107 emitters are fixed mount, i.e. not mobile. These emitters are plotted by frequency in Figure 3. Figure 3 had a limit imposed on the plotter so that the frequencies with zero emitters assigned could be differentiated from those with just a few emitters assigned. The assumption was that if there are over 50 emitters assigned the RFI would probably be significant. Where the line goes to 50 emitters, the actual number was greater than 50 emitters. At the frequencies 6.585, 6.605, 6.625, 6.645, 6.665 and 6.685 GHz, the actual numbers were between 160 and 250 emitters at each frequency. At the frequencies 6.595, 6.615, 6.635, 6.655, 6.675, and 6.695 GHz, the actual number of emitters per frequency was between 60 and 90 emitters.

In addition to the fixed emitter file, ECAC has a file of non-fixed emitters. This file is by emitter platform/vehicle. For purposes of a geographic sort on mobile emitters the location of the vehicle's home base or port was used. Also the mobile emitters are tuneable over a range rather than fixed in frequency. Because of this, they could not be included in the plotted data, Figure 4.

The ECAC data base search found the following vehicles in the geographic boundary defined earlier.

9	unclassified vehicle types
16	CONFIDENTIAL vehicle types
146	SECRET vehicle types
171	total vehicle types

82	vehicle types - Water
76	vehicle types - Air
12	vehicle types - Land
1	vehicle type - Other
171	total vehicle types.

These 171 vehicle types have 248 equipments that radiate within the 6.5 to 6.7 GHz range. There are 3208 antennas assigned to this equipment.

A description of each emitter and its exact location was provided by ECAC. Since these data are contained in a SECRET computer printout format that is over 3 inches thick, the data are not contained in this report. The potential for interference from emitters that have harmonics in the 6.5 to 6.7 GHz range was not assessed.

In summary, the over 3000 emitters in the 6.5 to 6.7 GHz range within the West Coast region of interest appear to provide a potential for a significant RFI problem. The exact antenna patterns and other RF characteristics of the SEASAT SMMR are not available at this time. However the SEASAT SMMR design characteristics called for a center frequency of 6.63 GHz with a prediction bandwidth of 0.100 GHz and an RF bandwidth of 0.250 GHz. Table 1 was extracted from: JPL Report No. 622-3 - Project Plan for SEASAT-A 1978 Mission, Jet Propulsion Laboratory, California Institute of Technology, November 1977. A review of the ECAC data shows that over half of the 3000 emitters are within 50 MHz of the 6.63 GHz frequency of interest. This report is intended to provide an assessment of the RFI potential that could bias the SEASAT SMMR data analysis. Nearly all of the emitters listed have average powers in excess of one watt and many

are a kilowatt or more. Appendix B, provided by J.P. Hollinger of NRL, shows that a one watt isotropic emitter located within the main beam of the SMMR will increase the antenna temperature at the SMMR by 6°K. Thus, even when viewed in a side lobe 30 or 40 db down from the main lobe, many of the emitters constitute significant RFI to the SMMR and can compromise or even prevent the attainment of mission goals.

LAMMR PRELIMINARY DESIGN DATA

In support of the NOSS LAMMR design effort, the ECAC data base was again accessed. Since the LAMMR is in the design phase, precise frequencies have not been selected. Table 2 details some of the options being considered for NOSS as presented in the NOSS System Description, 23 March 1979. There are, however, frequency ranges of more interest than others for geophysical reasons alone. Table 3 describes the most likely configuration for the NOSS LAMMR. Table 4 is from Appendix E, Technical Requirements Document dated 17 August 1979 which is part of the NASA NOSS RFP 5-19625/301 dated 3 October 1979. Therefore the following frequency ranges were used to access the ECAC data base: 3.0 to 7.6 GHz, 10.5 to 11.0 GHz, 13.4 to 14.0 GHz, 14.5 to 14.7 GHz, 17.0 to 18.8 GHz, 20.8 to 22.4 GHz, 34.0 to 35.5 GHz, 36.0 to 37.0 GHz, 76.0 to 77.0 GHz and 88.0 to 94.0 GHz.

The data from ECAC were provided in the plotted form as well as a detailed listing. The data were plotted for the world, and then for each of three regions. Regions 1, 2, and 3 are as shown in Figure 2. In general Region 1 is North and South America, Region 2 is Europe, all of Russia, Africa, and the near-East, and Region 3 is the rest of Asia including Japan and Australia.

The data have been organized as follows: for each frequency range of interest the first graph is for the entire world followed by the graph for Regions 1, 2, and 3. Table 5 is a summary of the total number of emitters plotted for the world and each Region by frequency range. Since the ECAC data base is continually being kept up-to-date, the total number of emitters for the regions does not equal the total for the world. However the differences are not of statistical concern for this analysis.

Figure 4 is the World plot for all 108,686 emitters in the 3.0 to 7.0 GHz range. Figure 4.1 is the Region 1 plot for that range, Figure 4.2 is the Region 2 plot and Figure 4.3 is the Region 3 plot. Each figure number follows this same order which will, hopefully, facilitate usage of the plotted data.

Some summary observations are appropriate for each set of figures. In Figure 4 it is of interest to note that most of the emitters are in the 3.72 to 4.20 GHz and the 5.94 to 6.43 GHz ranges. From 6.58 to 6.88 GHZ, there is a smaller concentration of emitters. Upon review of Figures 4.1, 4.2, and 4.3 it is important to note that 71% of all emitters are in Region 2 which is North and South America. (See Figure 2.) The 3.0 to 7.6 GHz range is analyzed further later in this paper.

In the 10.5 to 11.0 GHz range nearly all, 85%, of the emitters transmit at 10.52 GHz. (See Figure 5.) 97% of the 14,000 emitters in the 10.5 to 11.0 GHz frequency range are located in Region 2. (See Figure 5.2.)

The 13.4 to 14.0 GHz range does not have very many emitters in it; only 557 total worldwide (See Figure 6.). There are only 23 emitters in Region 1. There are only 8 emitters in the 13.6 to 13.8 GHz range in Regions 1 and 3 combined. (See Figures 6.1 and 6.3.

From Figure 7 we see that there are only 69 emitters worldwide in the 14.5 to 14.7 GHz range. Of these over 70% are in Region 2. (See Figure 7.2.)

Figure 8 shows that there are 77 emitters worldwide in the 17.0 to 18.8 GHz range. From 18.02 to 18.80 GHz there is only one emitter in Regions 1 and 2 combined. (See Figures 8.1 and 8.2.)

The range of 20.8 to 22.4 GHz has only 21 emitters assigned worldwide. (See Figure 9.) In the 34.0 to 35.5 GHz and the 36.0 to 37.0 GHz range there are a total of 124 emitters worldwide. (See Figures 10 and 11.) Of note is the fact there are no emitters within 110 MHz of 36.5 GHz. (See Figure 11.)

For the ranges of 76.0 to 77.0 GHz and 86.0 to 92.0 GHz the ECAC data base seems to be a bit erratic. From Figure 12 shows no emitters worldwide in the 76.0 to 77.0 GHz range, however Figure 12.2 shows one emitter at 76.72 GHz in Region 2. The emitter plot for the 88.0 to 92.0 GHz range shows an emitter at 88.68 somewhere in the world. (See Figure 12.) However from Figures 13.1, 13.2, and 13.3 we see that it is not in Regions 1, 2, or 3. Of importance here is not the fact that when the massive ECAC data base is searched some errors occur. What is important is that there are practically no emitters in either of these two ranges to interfere with the NOSS LAMMR.

FURTHER ANALYSIS OF 3.0 TO 7.6 GHZ RANGE

For all of the ranges selected the definite conclusions can be made relative to the level of RFI that should be observed by LAMMR. In the 3.0 to 7.6 GHz range, however, it seemed important to go back to ECAC and request a narrower seach in the three ranges where it appeared that there are fewer emitters. From Figure 4, the following ranges were selected, 3.00 to 3.70 GHz, 4.21 to 5.91 GHz and 6.440 to 6.544 GHz. In addition ECAC was requested to search the mobile emitter data base in the ranges as well. The ECAC plots were structured to provide as much data on frequencies with few emitters as possible. Therefore the ordinate range was limited to 50 emitters.

From Figure 14 the range of 3.12 to 3.38 GHz appears to provide the clearest range. However a review of the emitter listing show that there are four megawatt plus radars which operate at 3.15 GHz on the East Coast of the United States. There are several megawatt plus radars that tune through this range as well.

In the 4.21 to 5.91 GHz range there appear to be two relatively clean ranges; 4.21 to 4.40 GHz and 5.02 to 5.36 GHz. (See Figure 15.) The emitter listing however shows that there are numerous radar altimeters assigned at 4.3 GHz. Included at 4.3 GHz is a NASA Space Shuttle Altimeter. The 5.02 to 5.36 GHz range has relatively few megawatt plus emitters assigned in the United States. Most high power units are European. Of the 754 units plotted in Figure 16, nearly all are microwave relay units with a power level of less than 100 watts.

The total number of emitters plotted in Figures 14, 15, and 16 is 8073. The emitter listing for these figures contains 8321 emitters. The difference is attributed to the fact that tuneable emitters are included in the emitter listing but not in the data plot if the lowest tunable frequency falls outside the limits of the plot. Of the 8321 emitters listed, 173 are classified SECRET and 482 are classified CONFIDENTIAL. These 8321 emitters are all fixed in location and are listed in a print-out volume, which is over 5-inches thick.

ECAC was also requested to search their mobile emitter file. This file is called the Organization and Platform File (OPAF). The OPAF listing for the three narrow ranges, 3.0 to 3.7 GHz, 4.21 to 5.92 GHz, and 6.44 to 6.58 GHz, contained 963 records. Of these records, 462 were Navy, 146 Air Force, 229 Commercial, 24 Army, 52 Marines, and 50 Coast Guard. Further there were 41 commercial air, 188 commercial water (shipboard), 397 Navy/Coast Guard water and 255 military air.

These 963 records listed 1462 equipments with 10,301 antenna records. An unclassified example of the data in an OPAF listing is presented in Appendix C. In the case of the maritime water listings, individual hulls are listed. But with the commercial air listing, classes of aircraft are listed without regard to how many there may be of each class. A parallel comparison may be made to the classified listings which deal with military vehicles.

Appendix D contains excerpts from the Final Acts of the International Telecommunication Union's World Administrative Radio Conference (WARC), Geneva, 1979 that cover the frequencies of interest. The first few pages of Appendix D contain excerpts from the Final Protocols of the 1979 WARC.

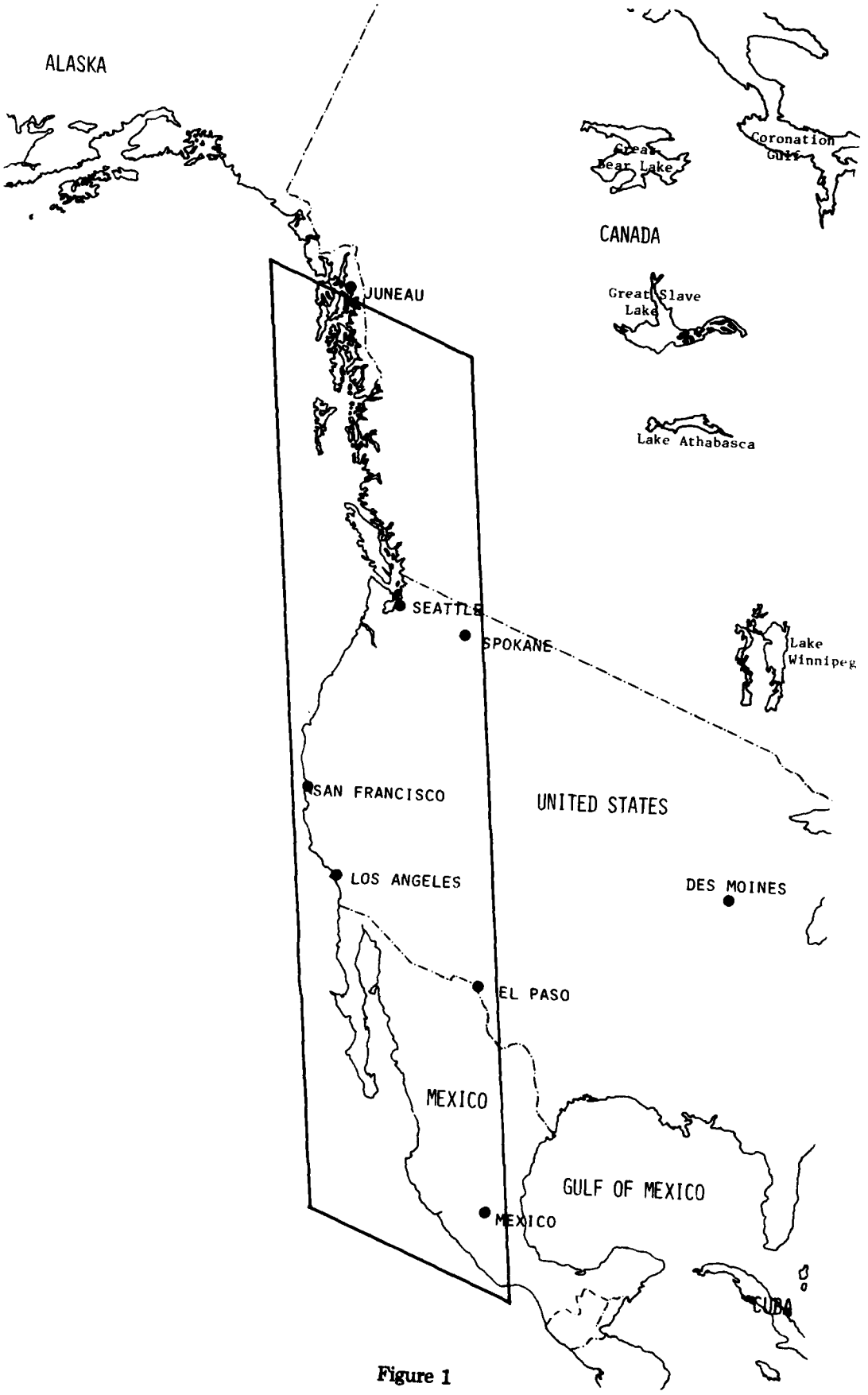
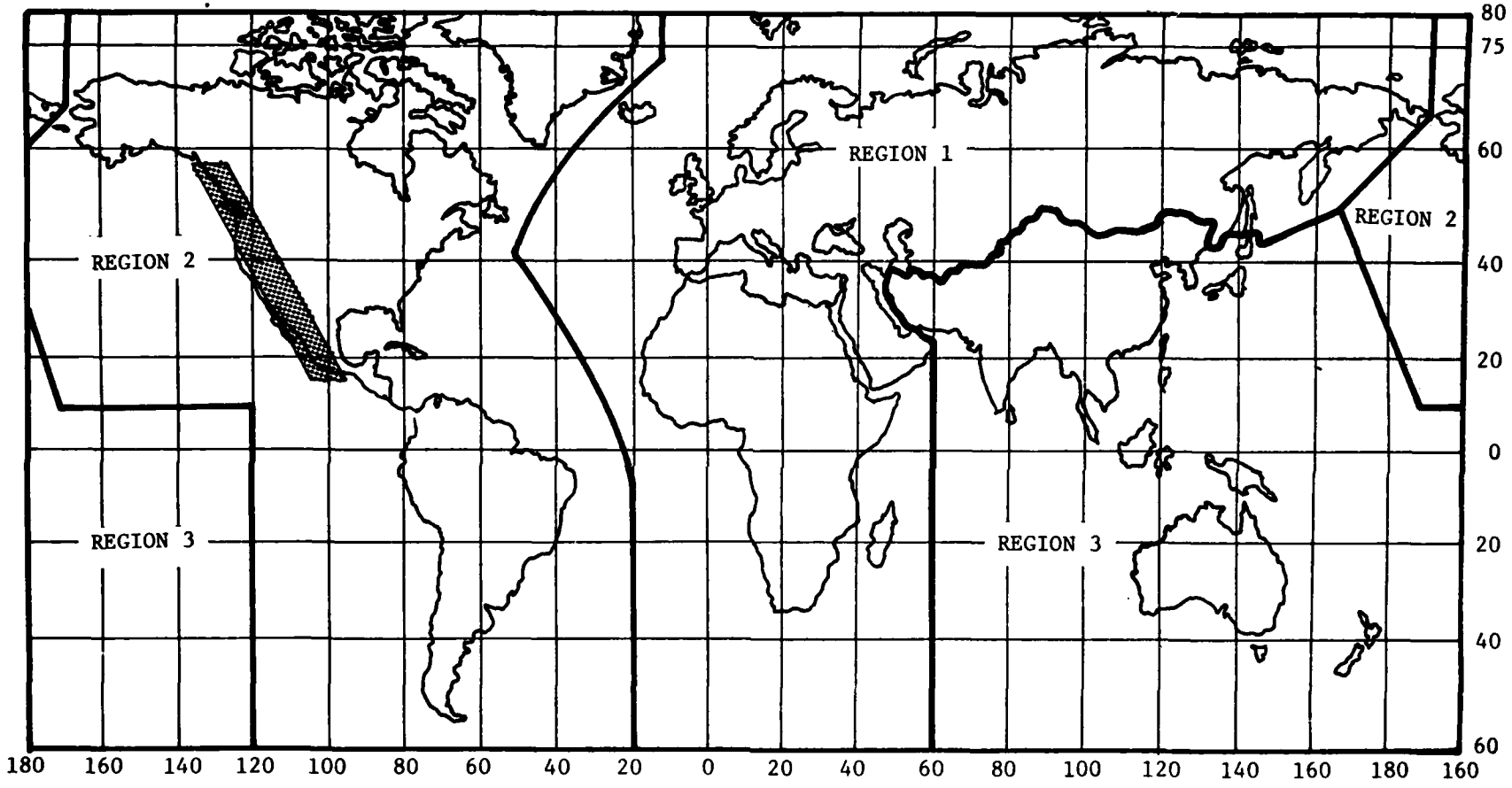

ALASKA
Great Bear Lake
Coronation Gulf
CANADA
JUNEAU
Great Slave Lake
Lake Athabasca
SEATTLE
SPOKANE
Lake Winnipeg
SAN FRANCISCO
UNITED STATES
LOS ANGELES
DES MOINES
EL PASO
MEXICO
GULF OF MEXICO
MEXICO
CUBA

Figure 1


REGION 1
REGION 2
REGION 2
REGION 3
REGION 3
80
75
60
40
20
0
20
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60
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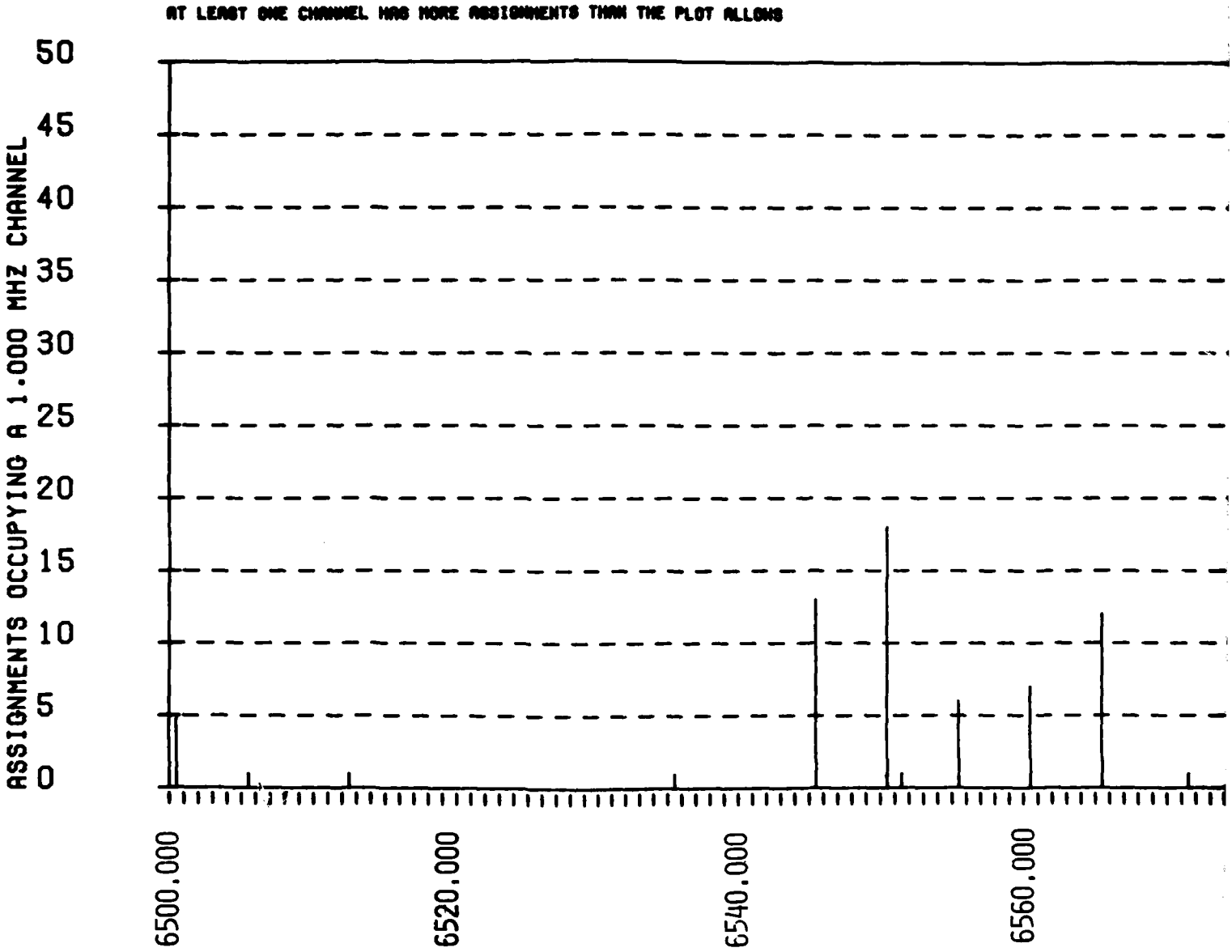
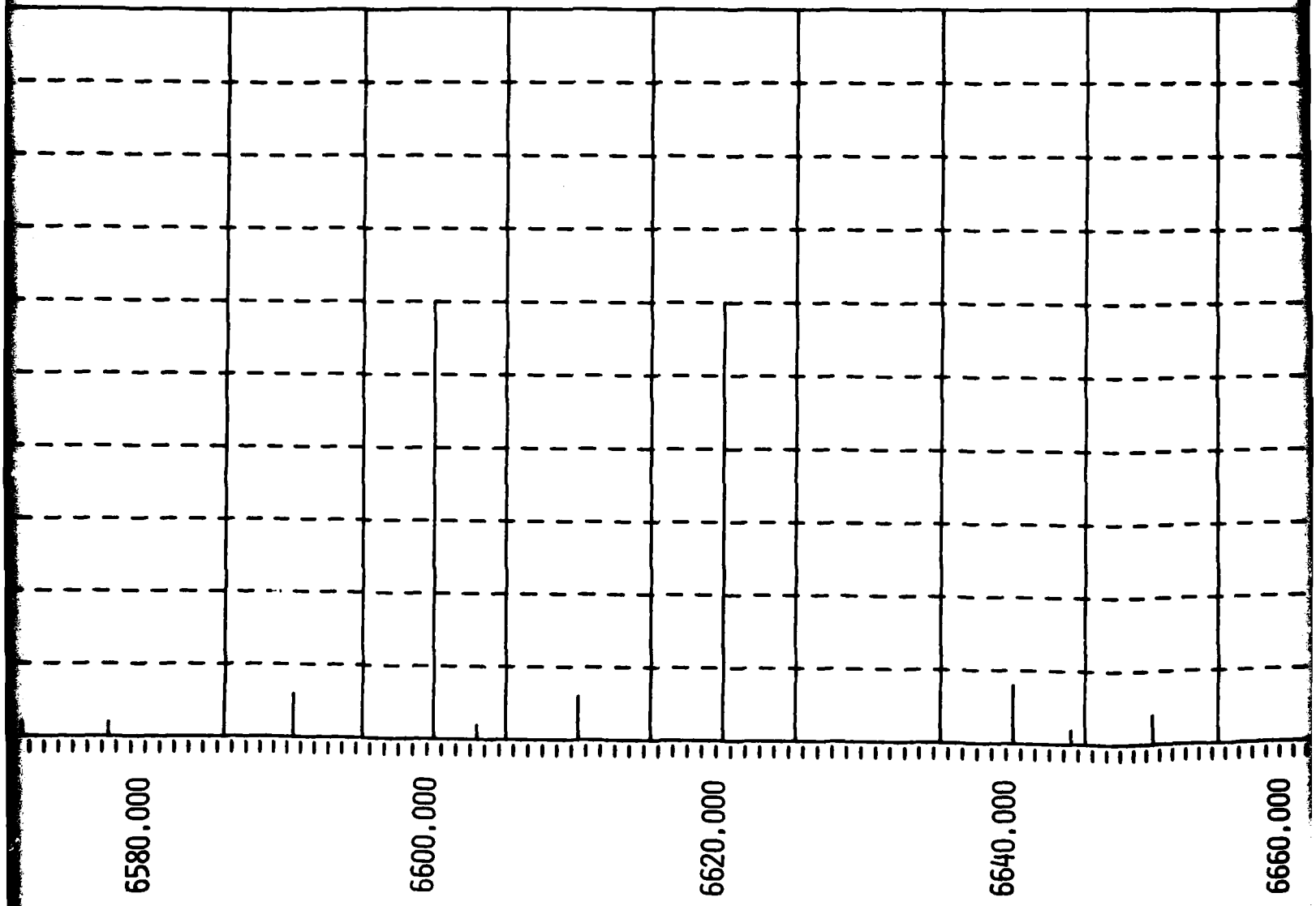
180
160

Figure 2


AT LEAST ONE CHANNEL HAS MORE ASSIGNMENTS THAN THE PLOT ALLOWS
ASSIGNMENTS OCCUPYING A 1.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
6500.000
6520.000
6540.000
6560.000

*See Figure 1.

WEST COAST OF NORTH AMERICA*
(6.5 to 6.7)



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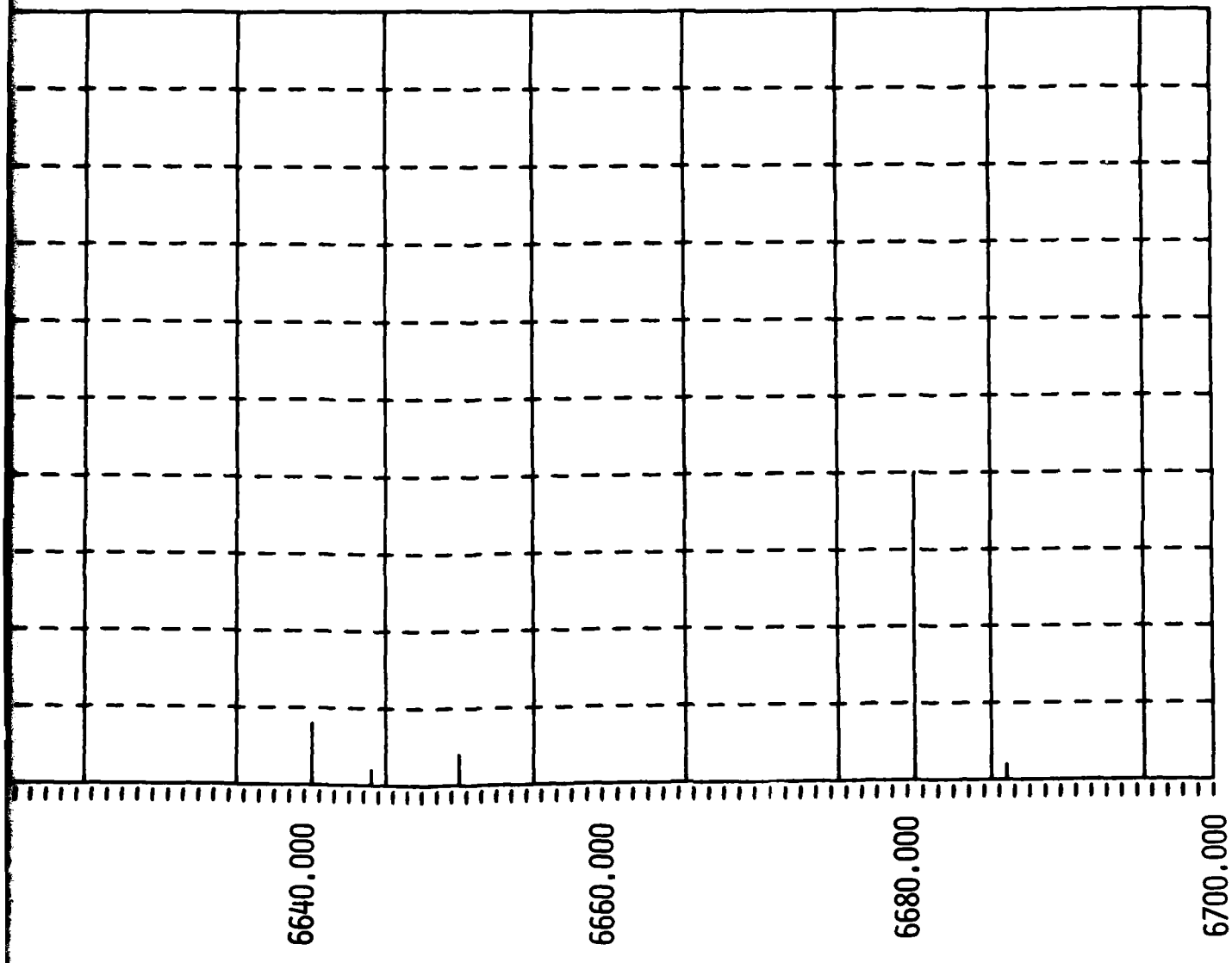

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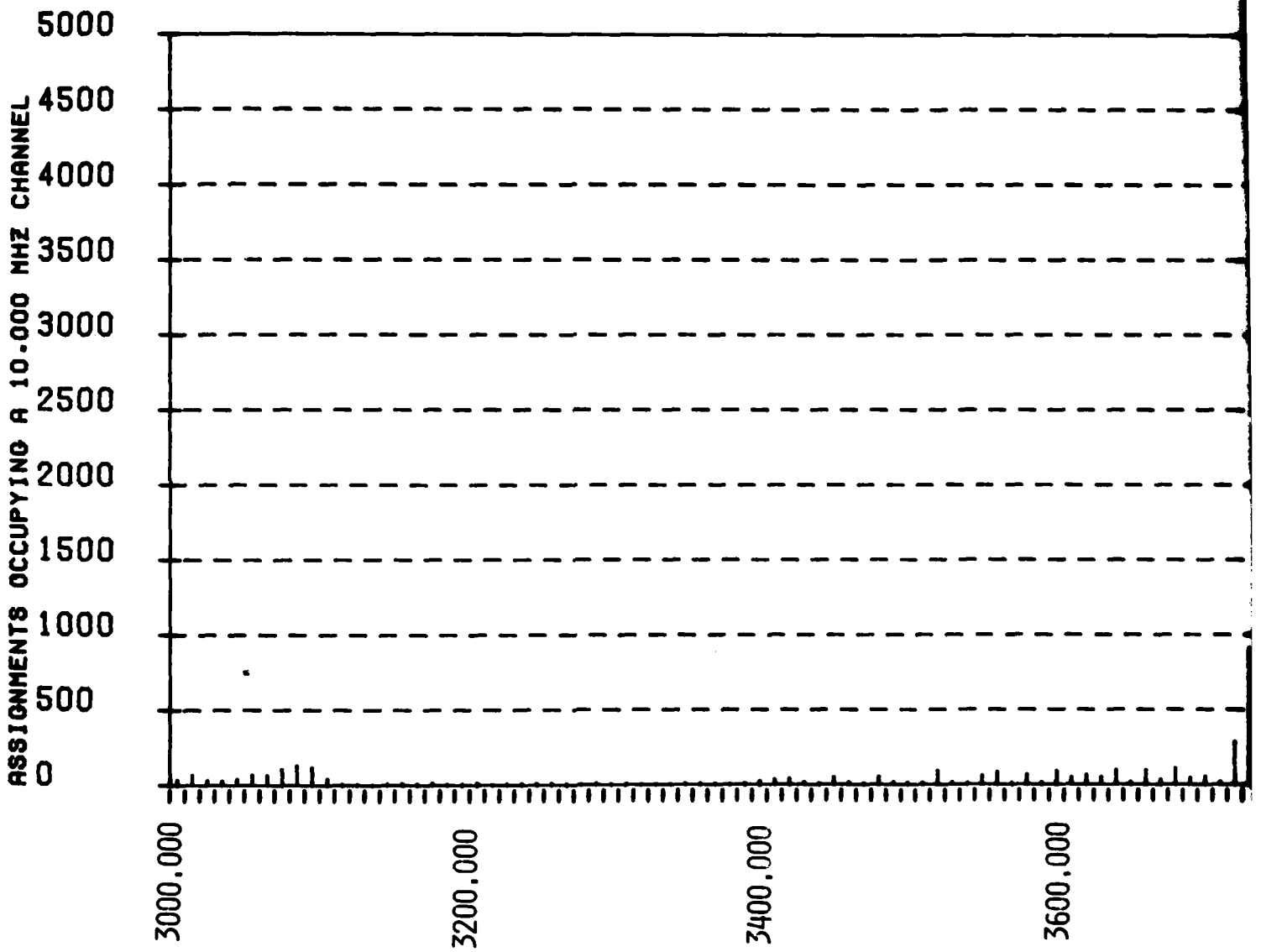
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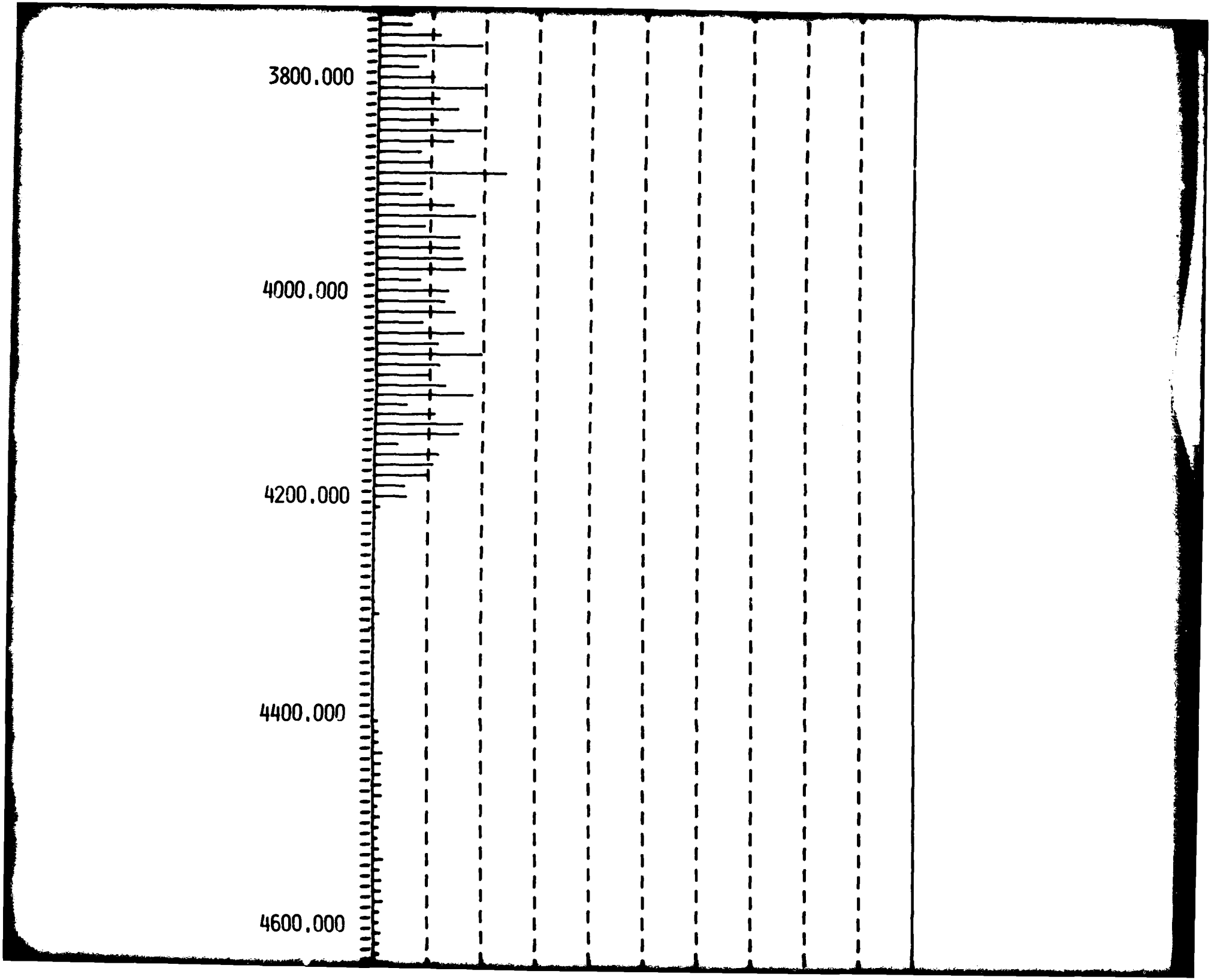
3600.000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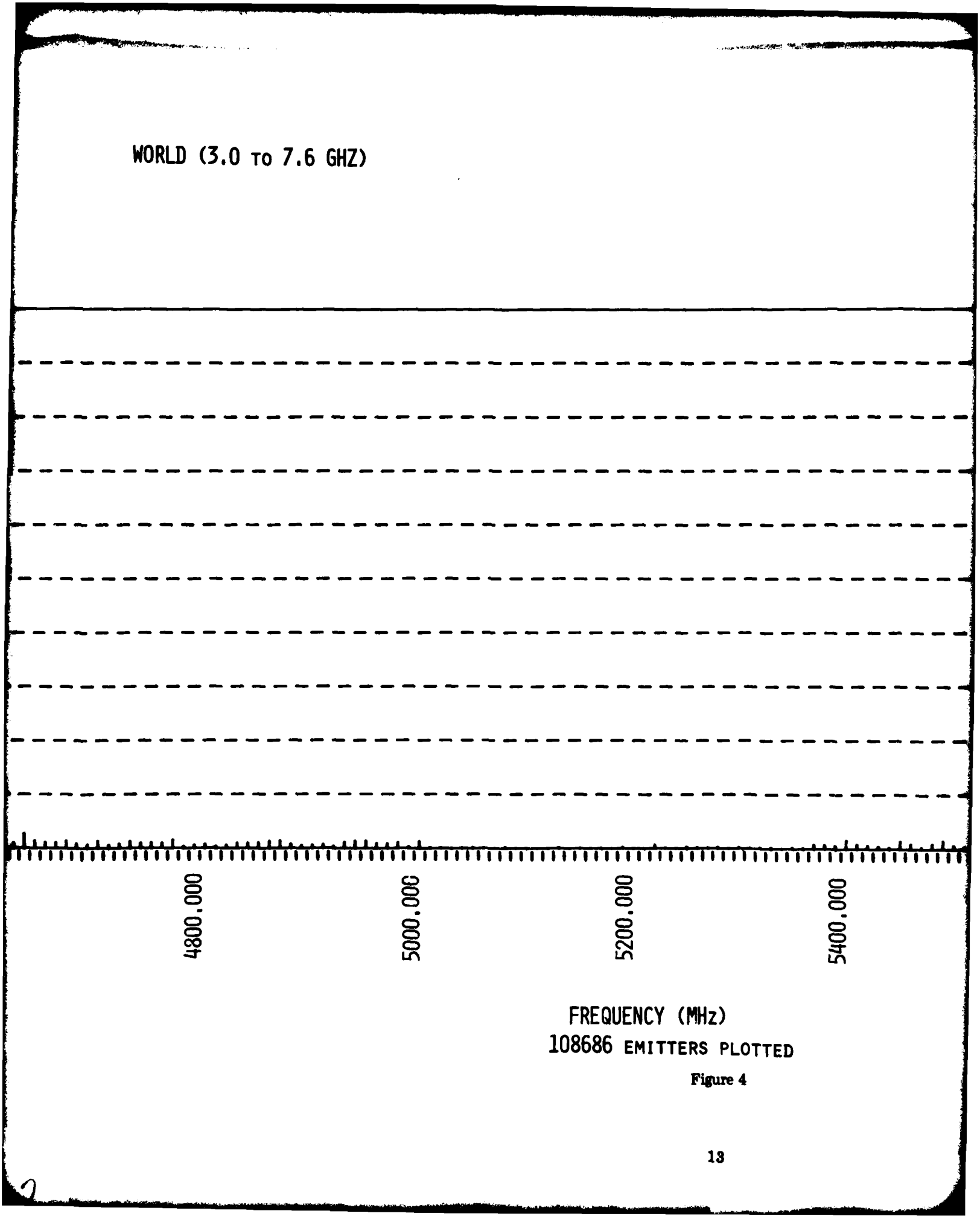
4200.000
4400.000
4600.000


WORLD (3.0 TO 7.6 GHZ)
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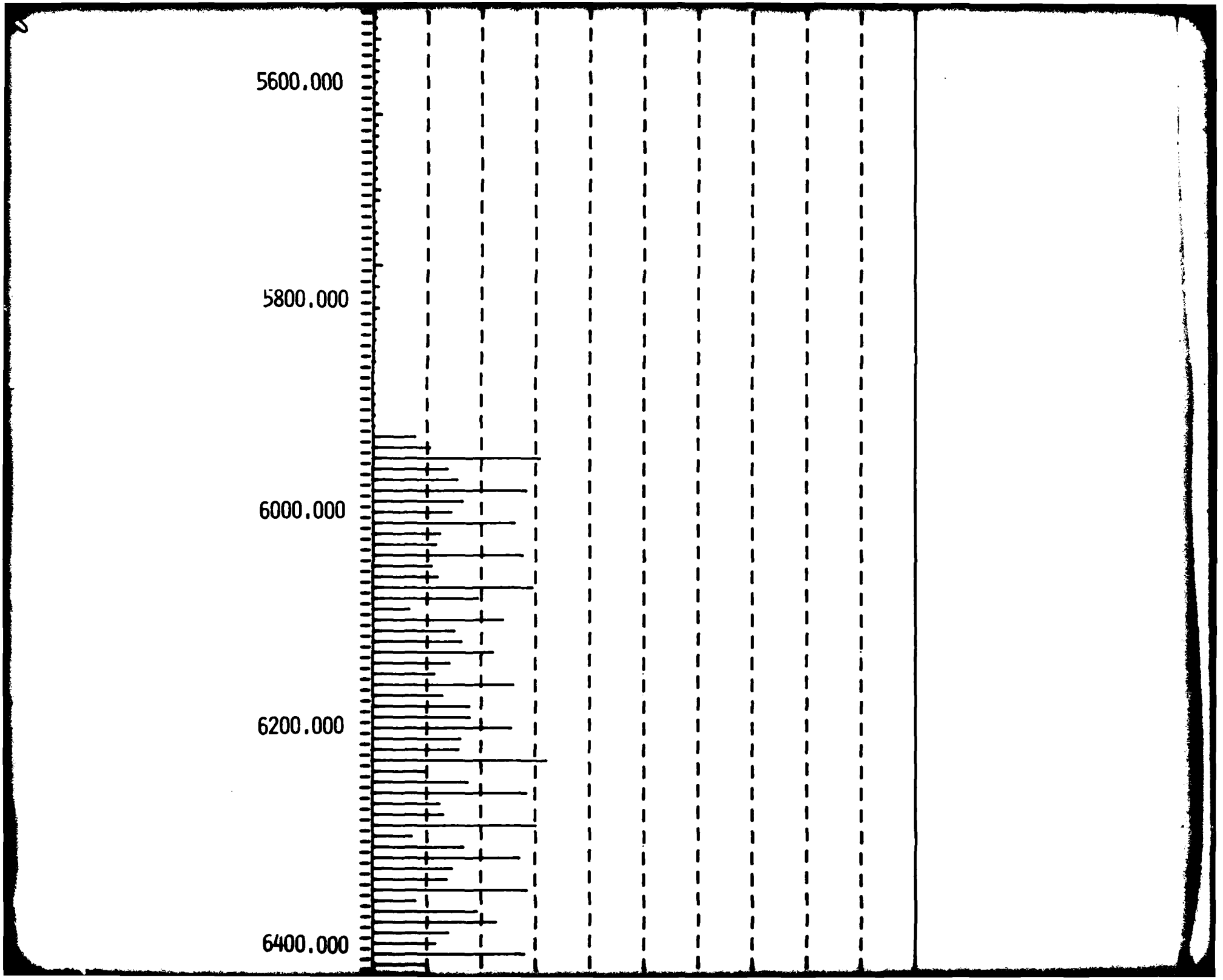
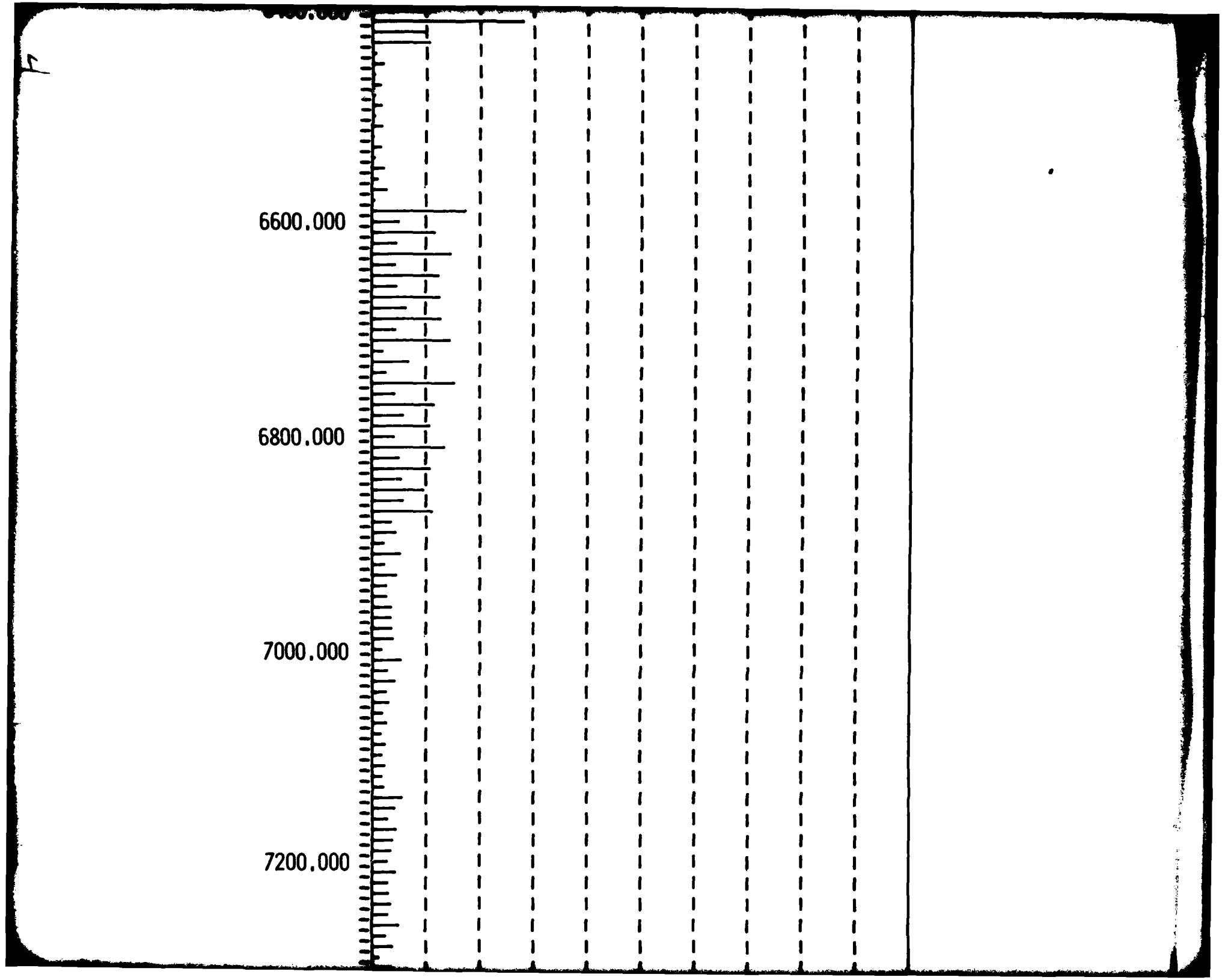
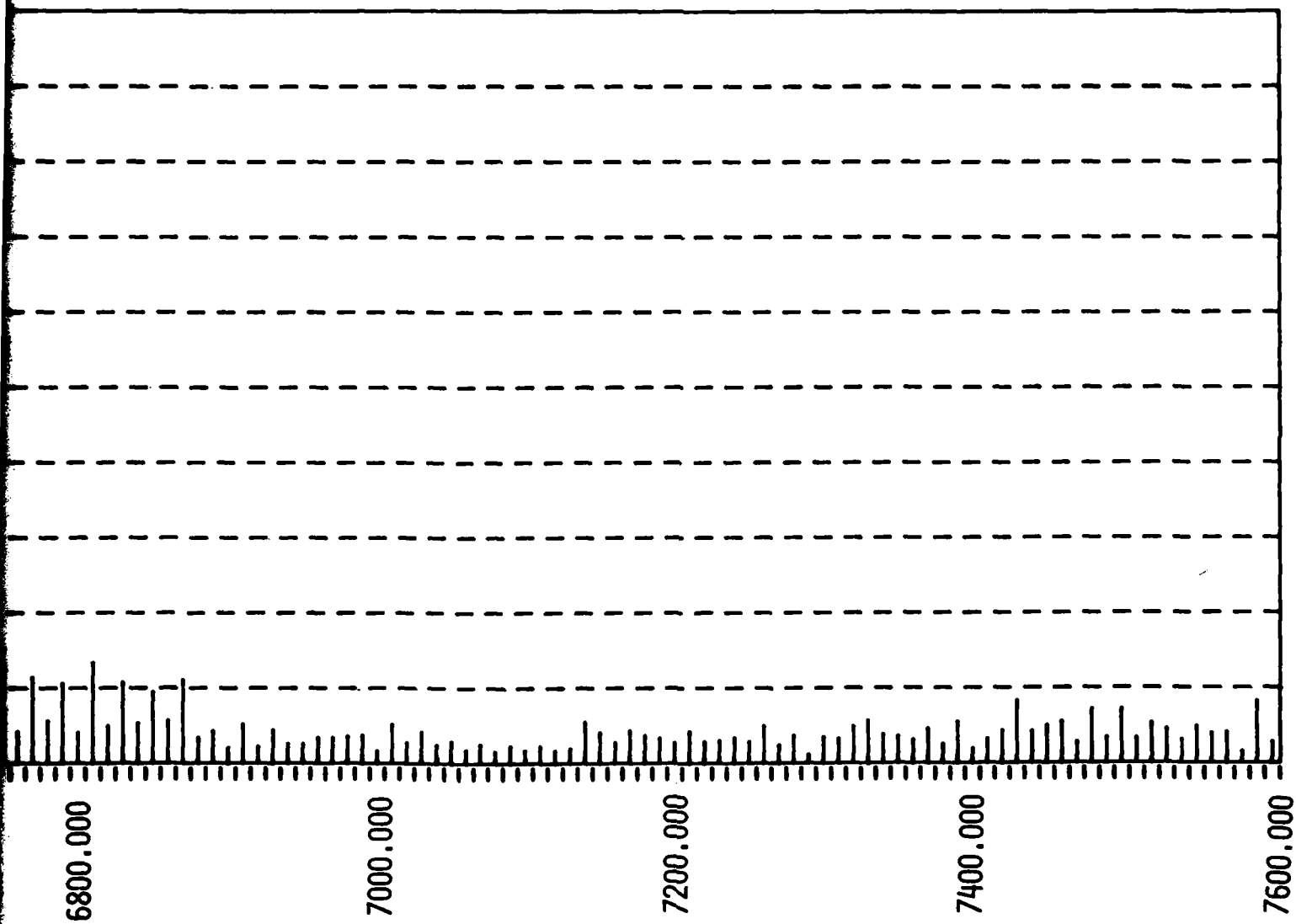
5200.000
5400.000
FREQUENCY (MHz)
108686 EMITTERS PLOTTED

Figure 4


5600.000
5800.000
6000.000
6200.000
6400.000


6600.000
6800.000
7000.000
7200.000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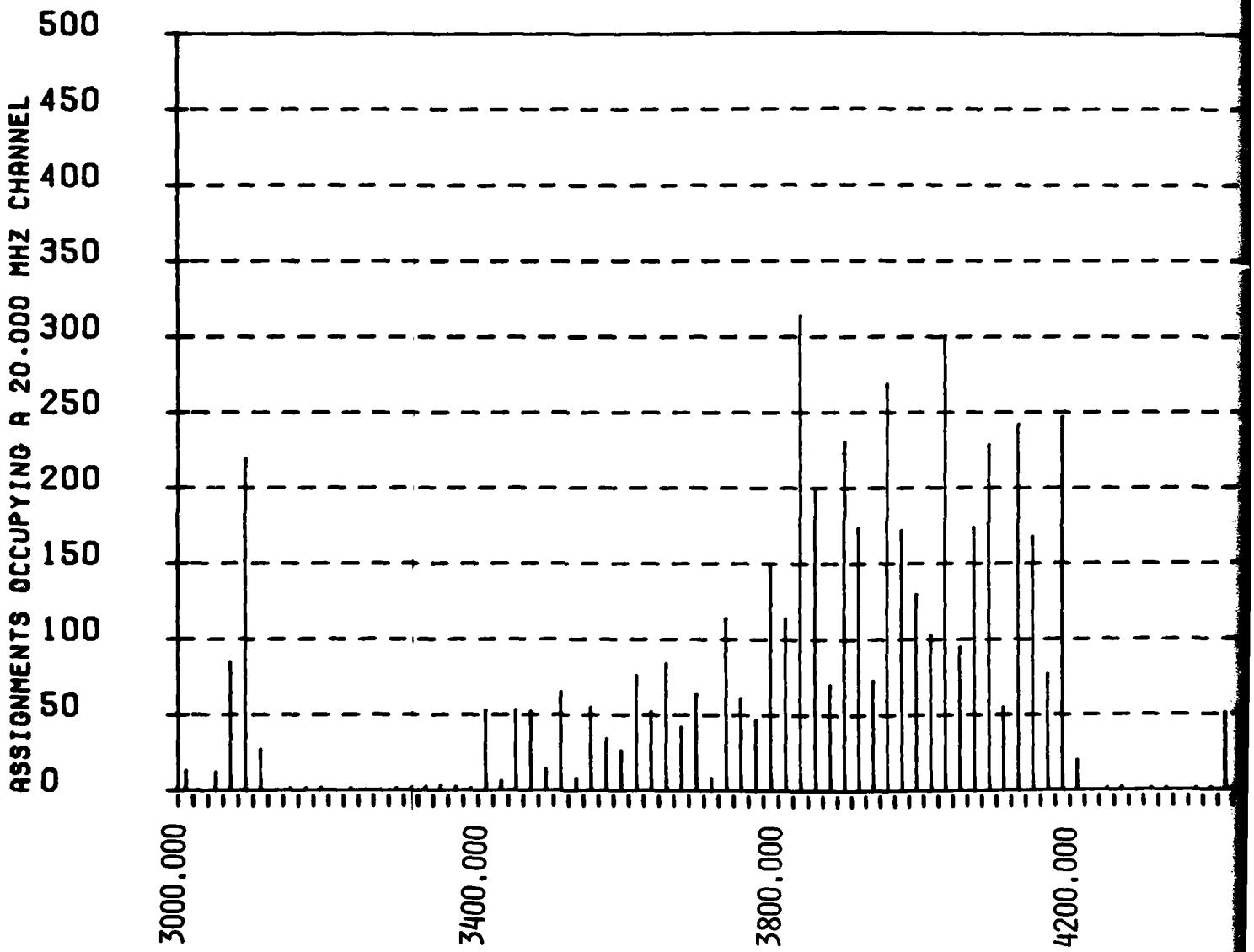
7000.000
7200.000
7400.000
7600.000

REGION 1 (3.


ASSIGNMENTS OCCUPYING A 20.000 MHZ CHANNEL
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300
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200
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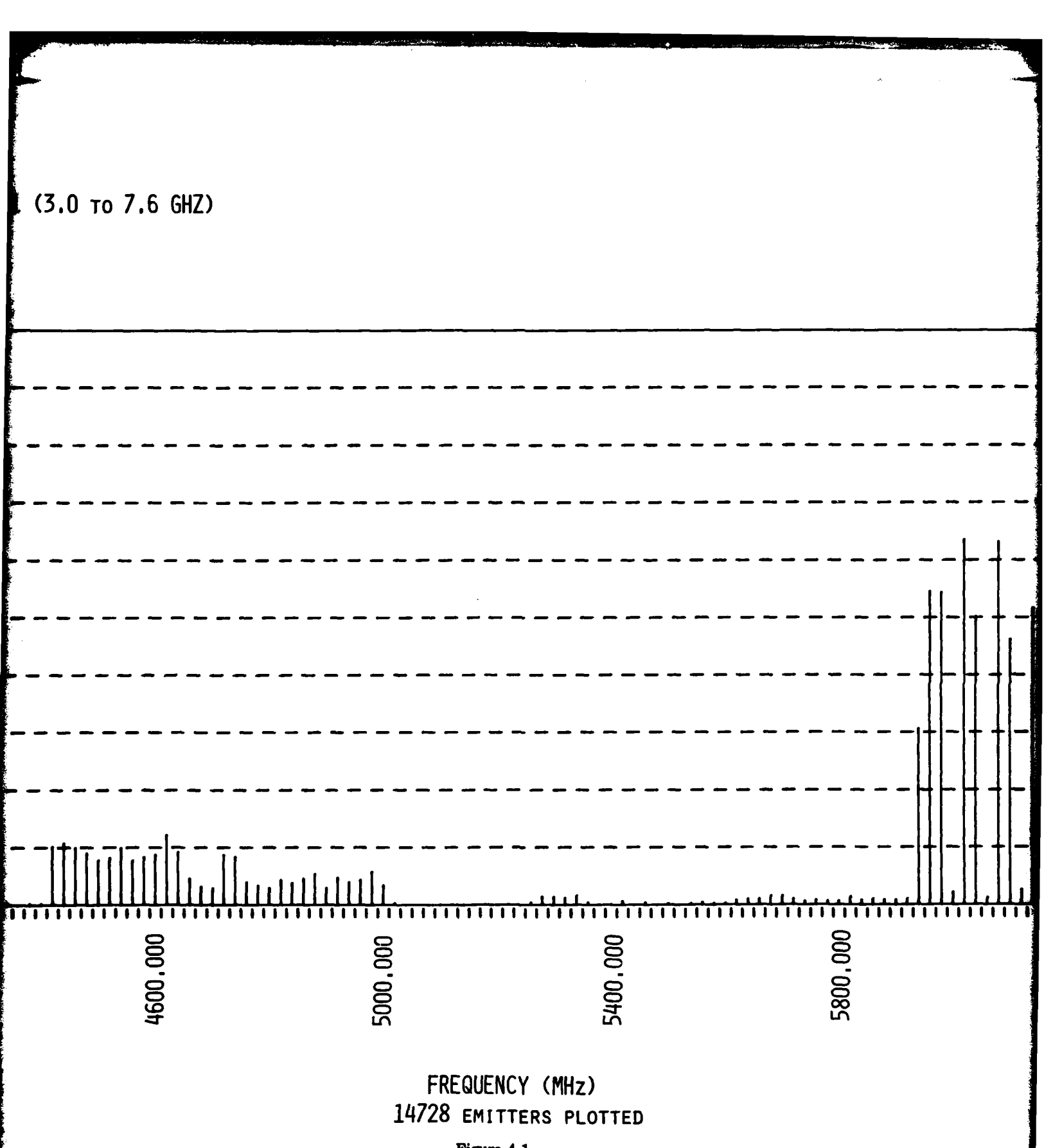
3800.000
4200.000


(3.0 TO 7.6 GHZ)
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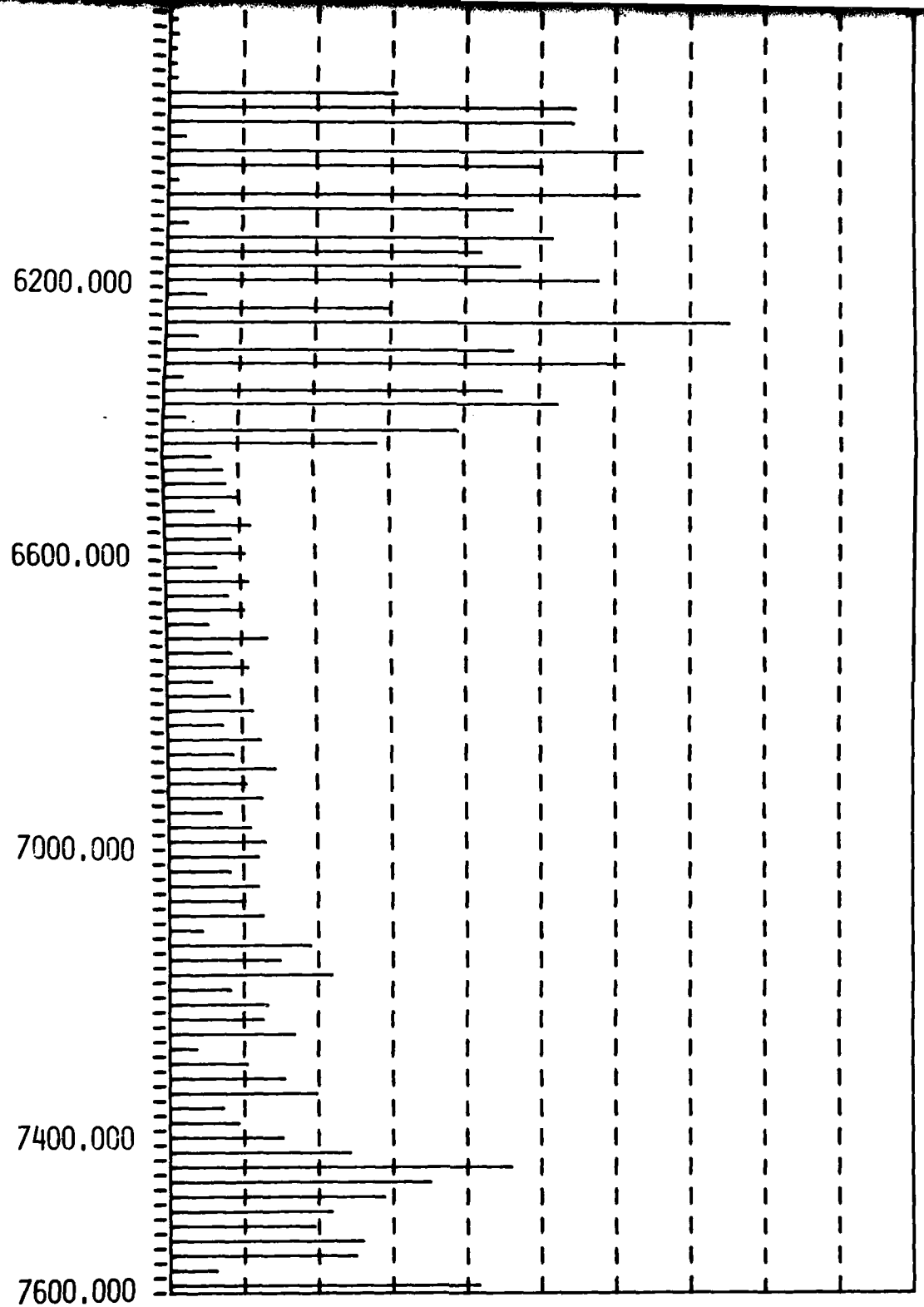
FREQUENCY (MHz)
14728 EMITTERS PLOTTED

Figure 4.1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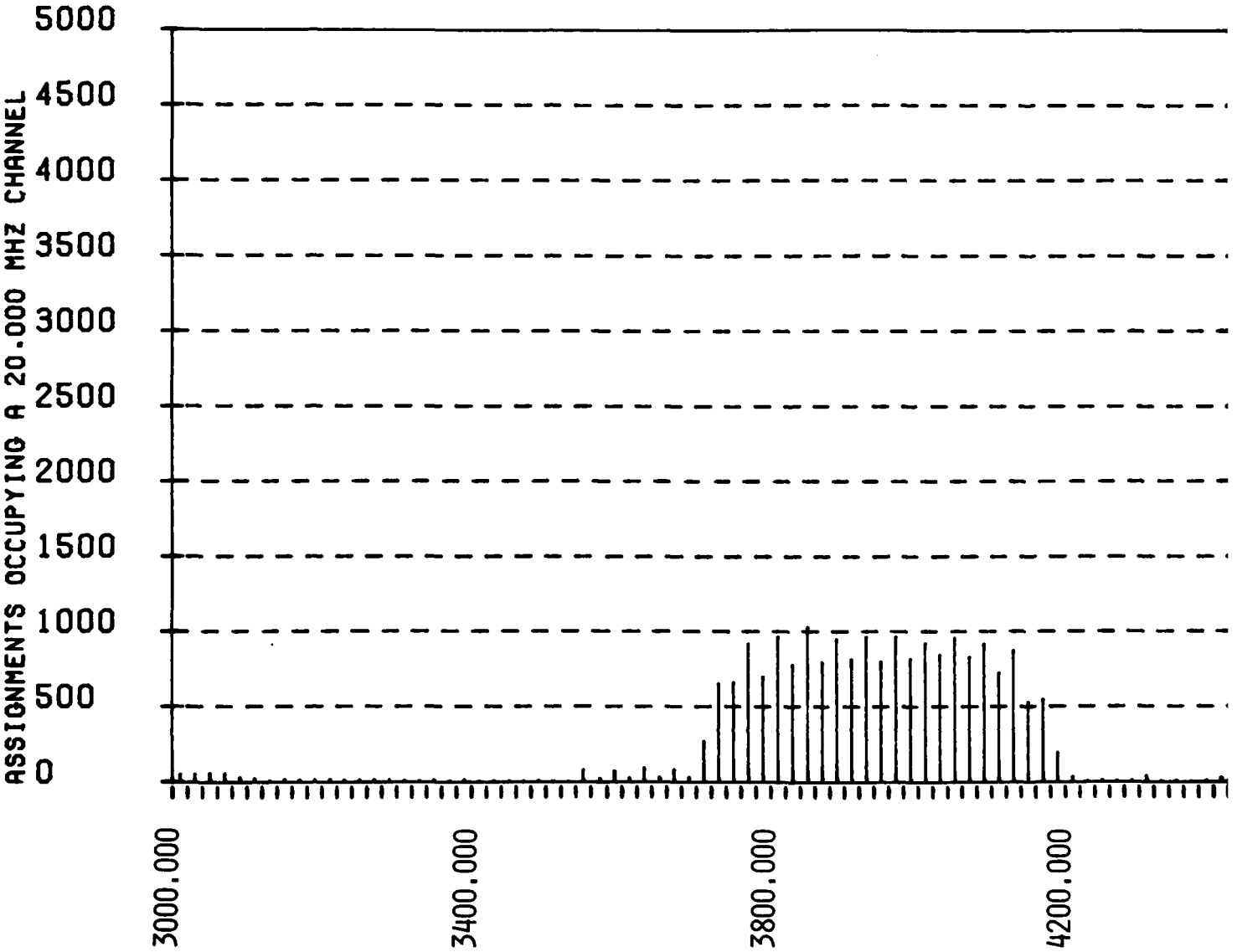
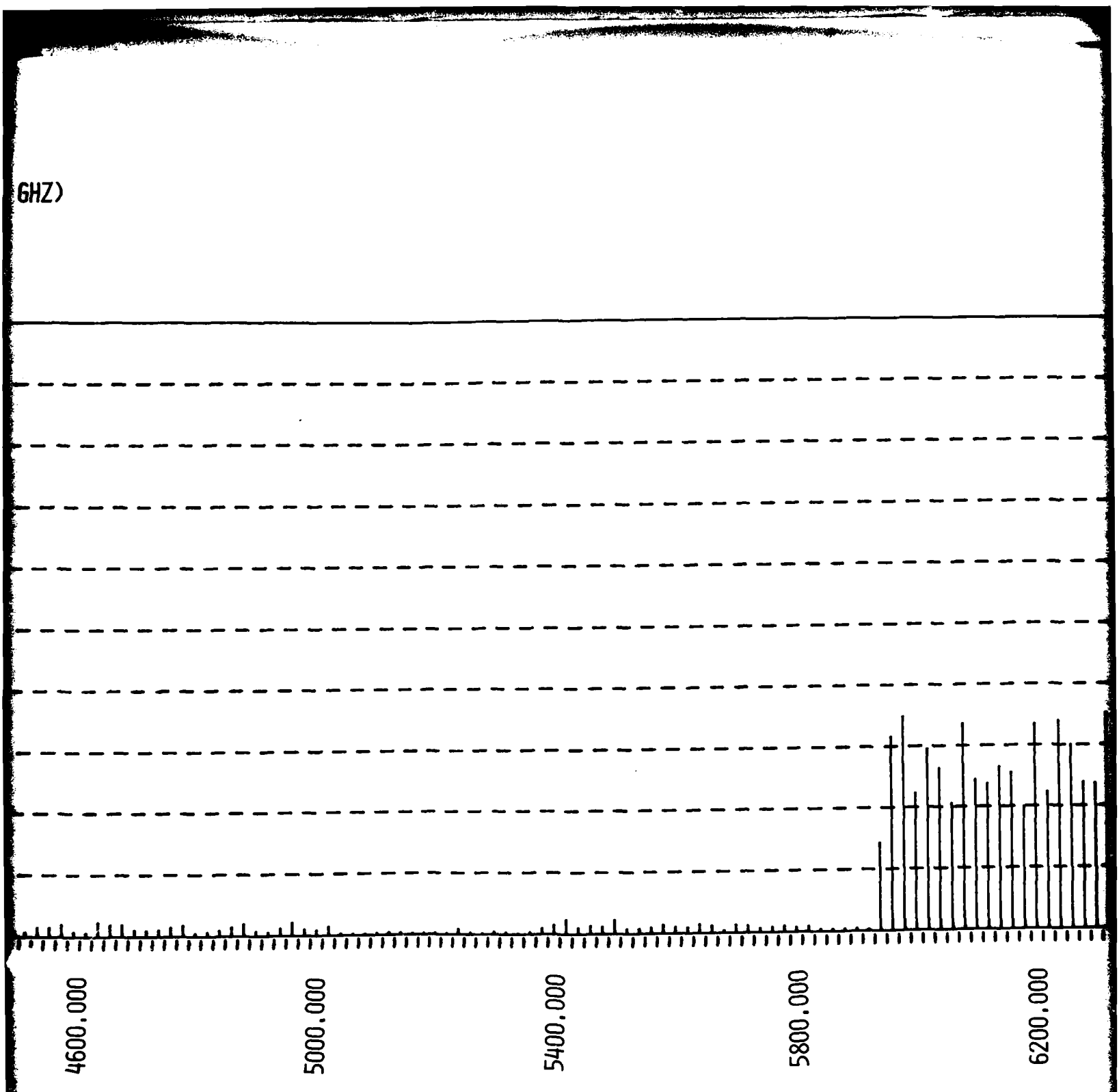
REGION 2 (3.0 TO

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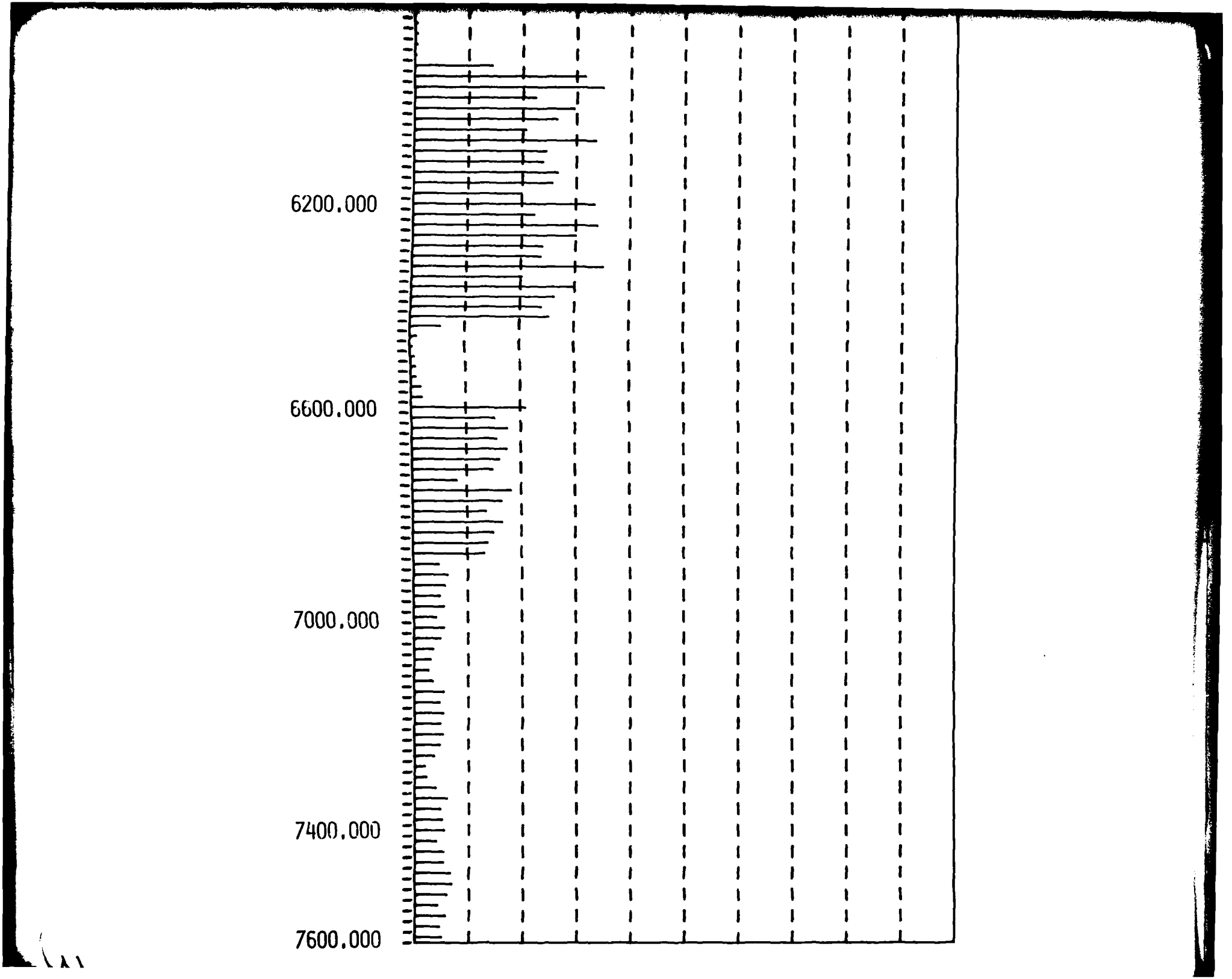
77283 EMITTERS PLOTTED

Figure 4.2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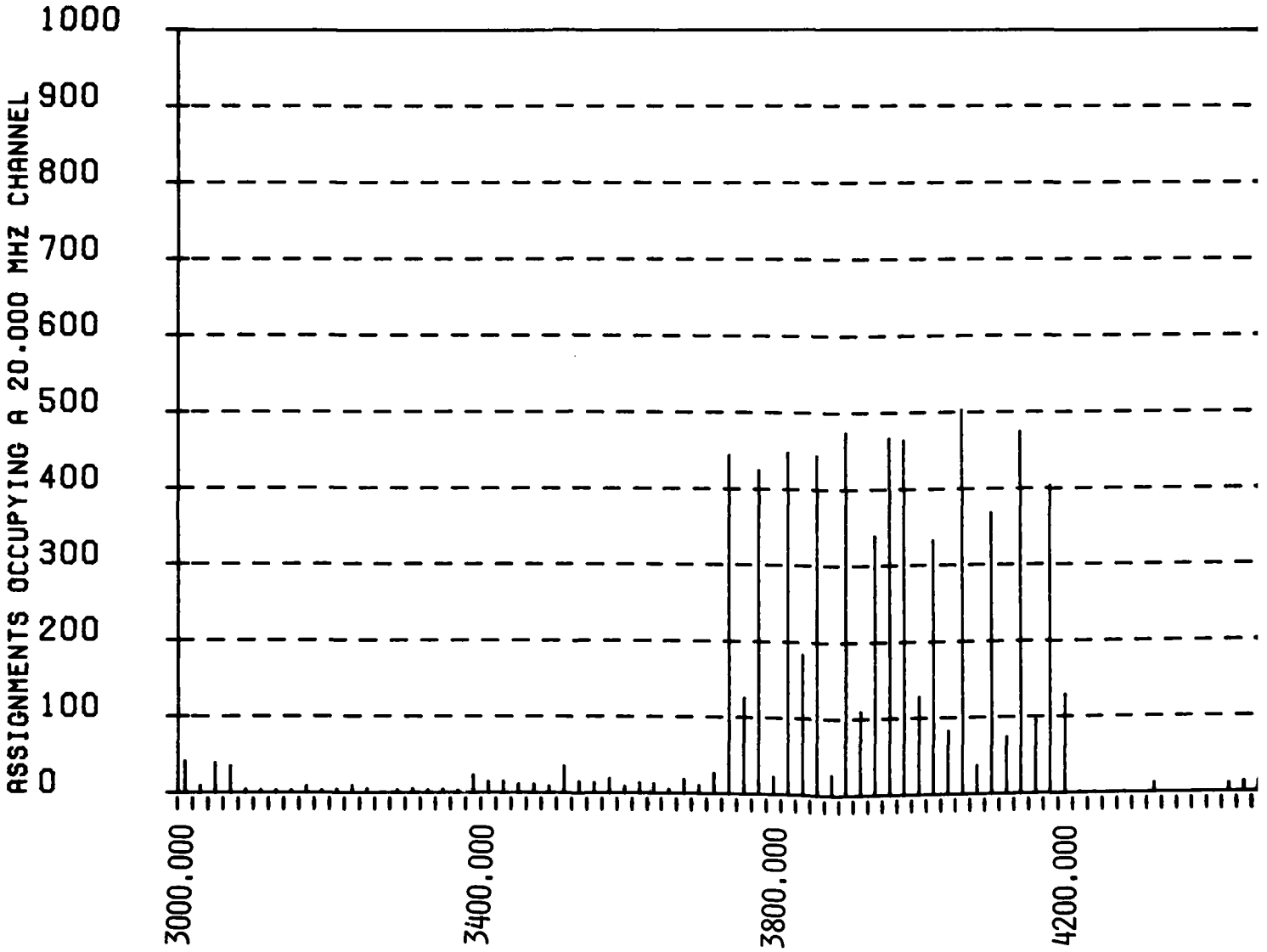
7600.000

REGION 3 (3.0 TO 7.



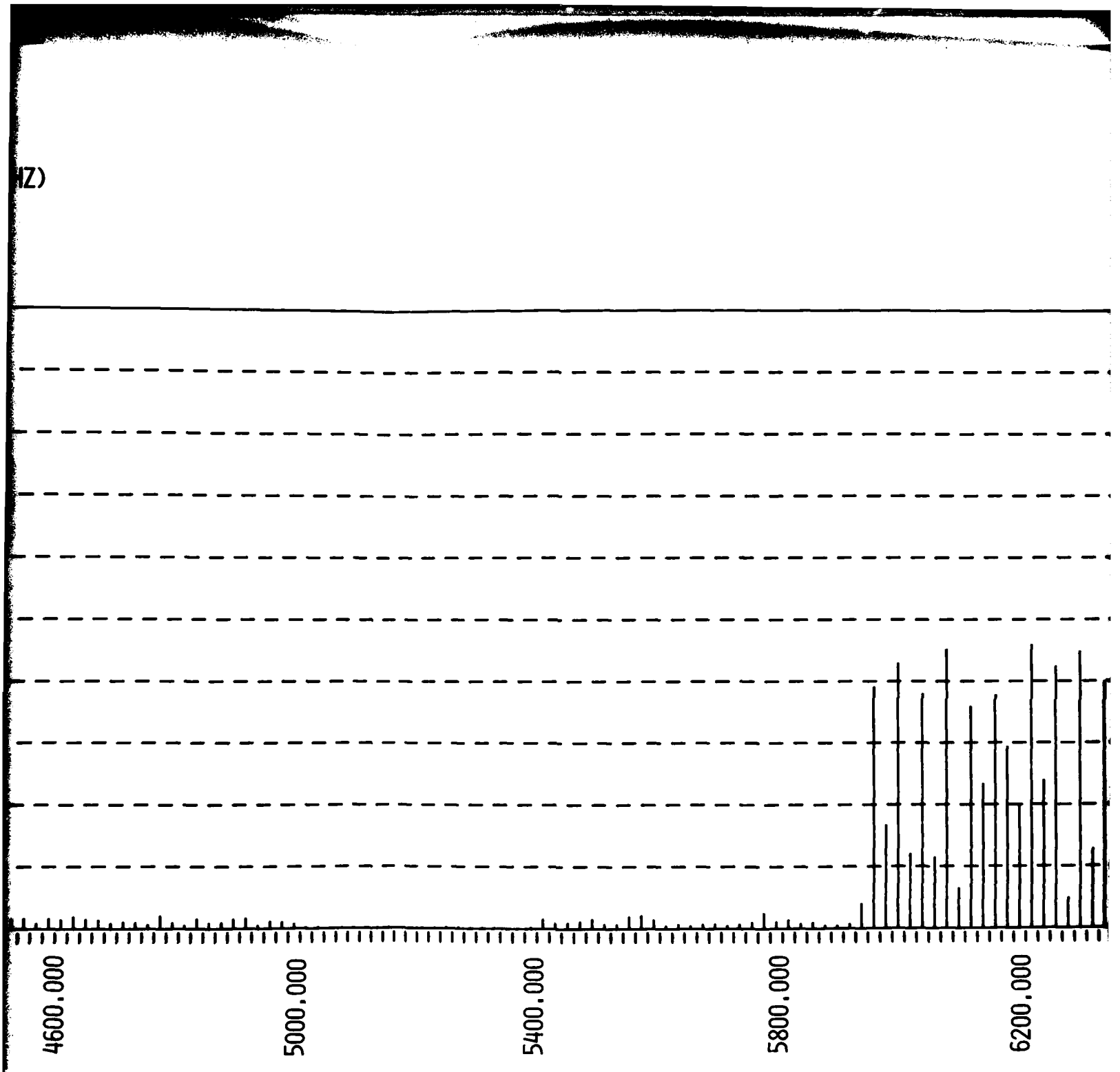
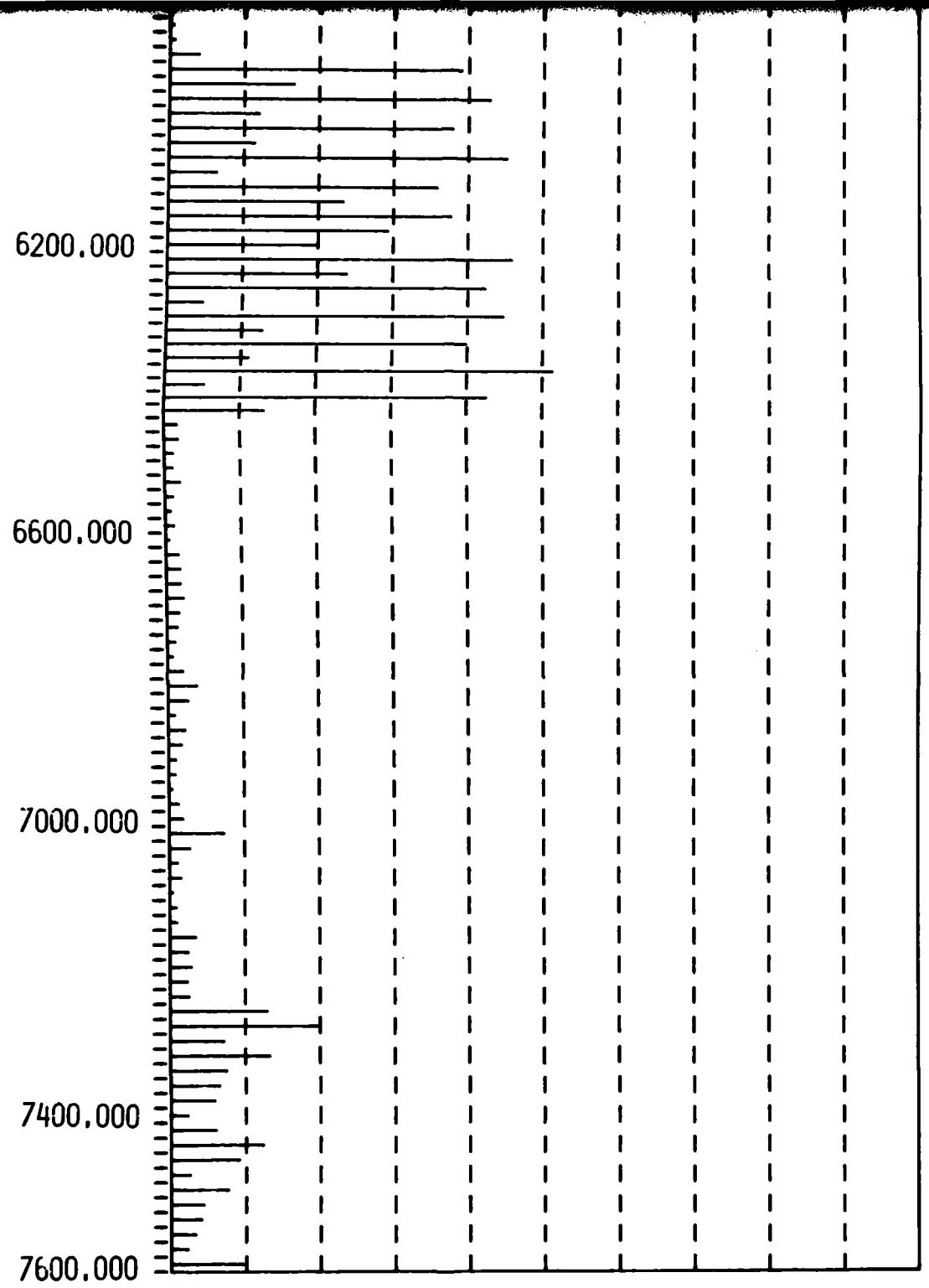

HZ)
4600.000
5000.000
5400.000
5800.000
6200.000
FREQUENCY (MHz)
16679 EMITTERS PLOTTED

Figure 4.3


6200.000
6600.000
7000.000
7400.000
7600.000

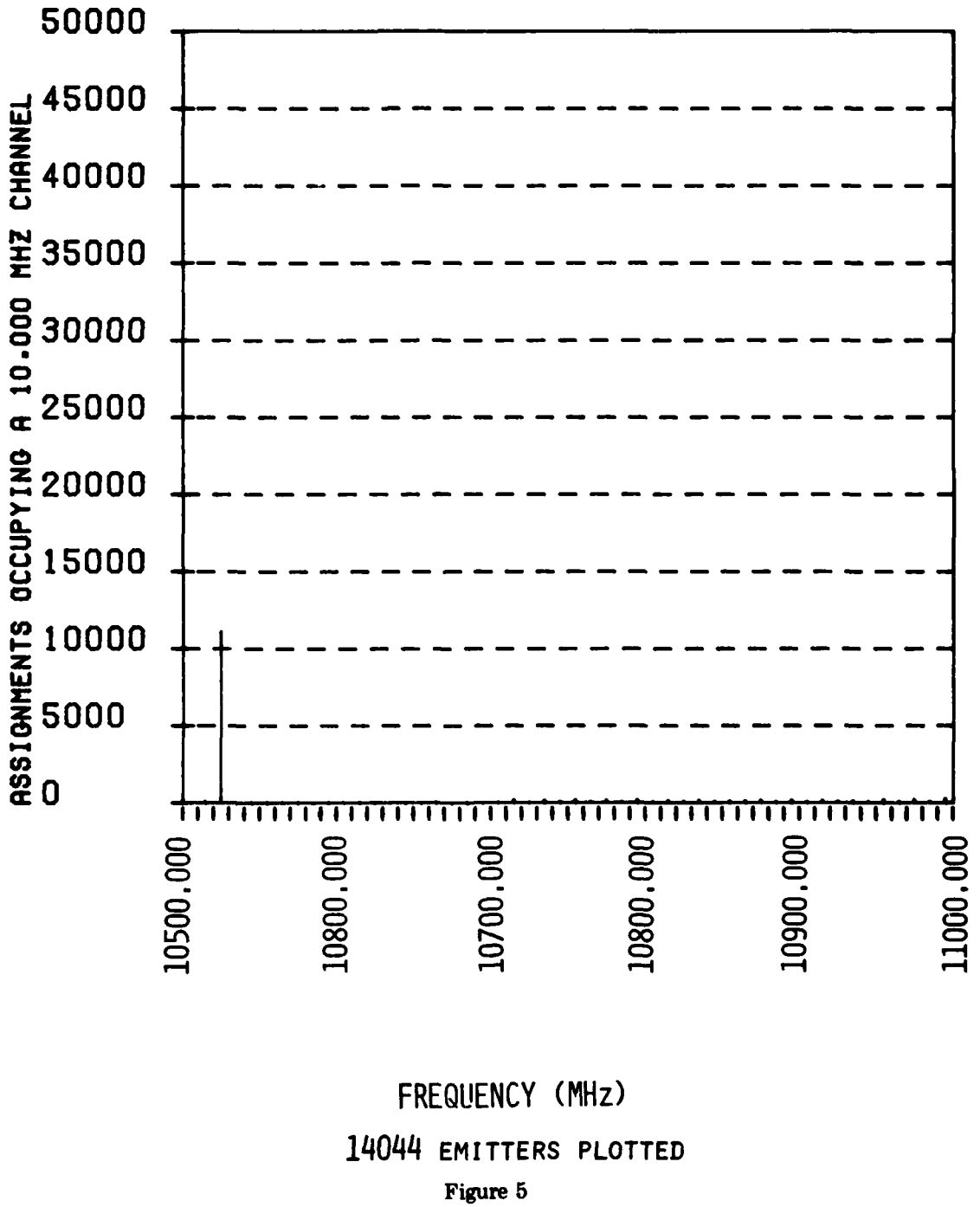

WORLD (10.5 TO 11.0 GHZ)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
10500.000
10600.000
10700.000
10800.000
10900.000
11000.000
FREQUENCY (MHz)
14044 EMITTERS PLOTTED

Figure 5

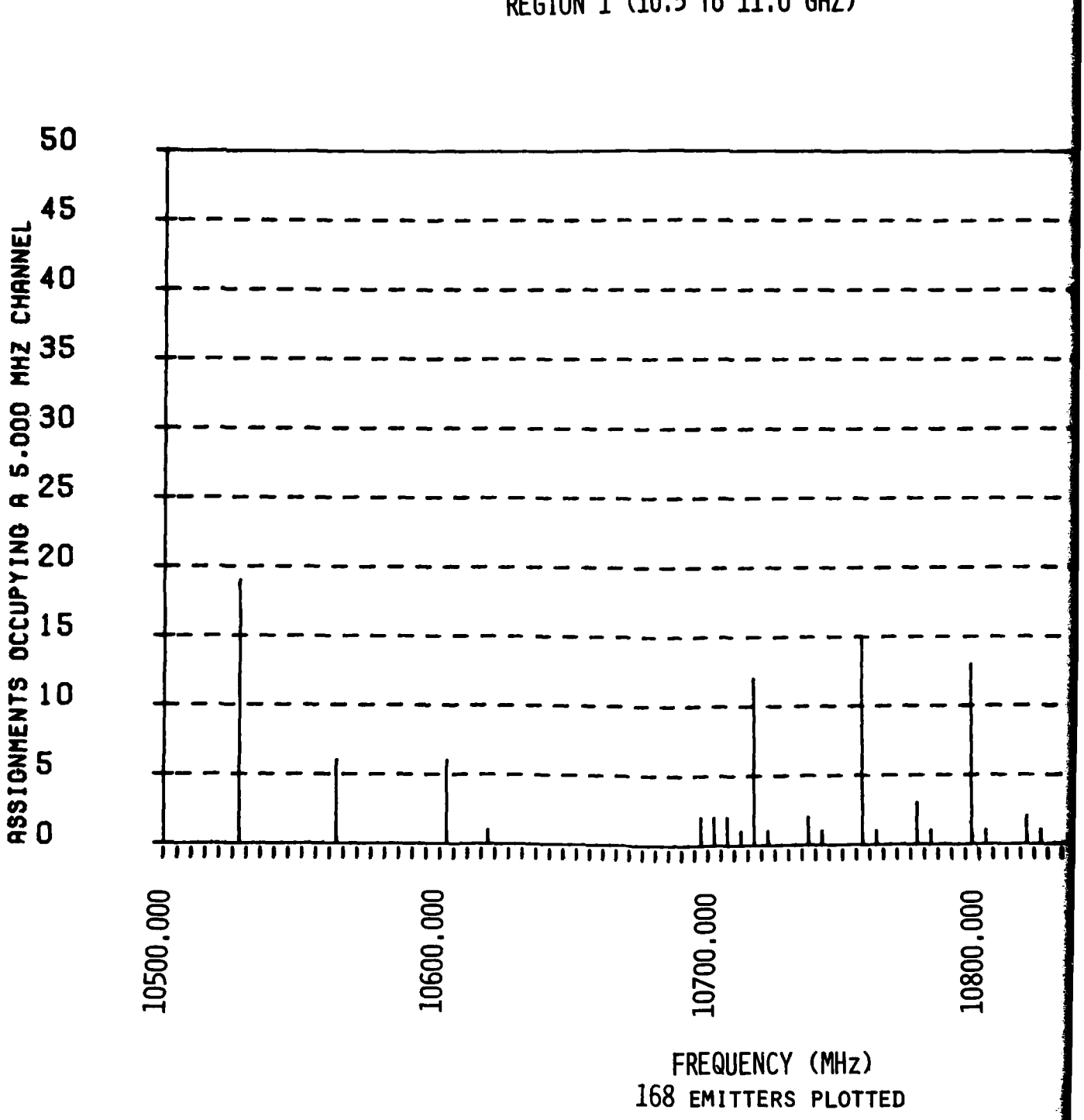

REGION 1 (10.5 TO 11.0 GHZ)
ASSIGNMENTS OCCUPYING A 5.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
10500.000
10600.000
10700.000
10800.000
FREQUENCY (MHz)
168 EMITTERS PLOTTED

Figure 5.1

REGION 1 (10.5 TO 11.0 GHZ)

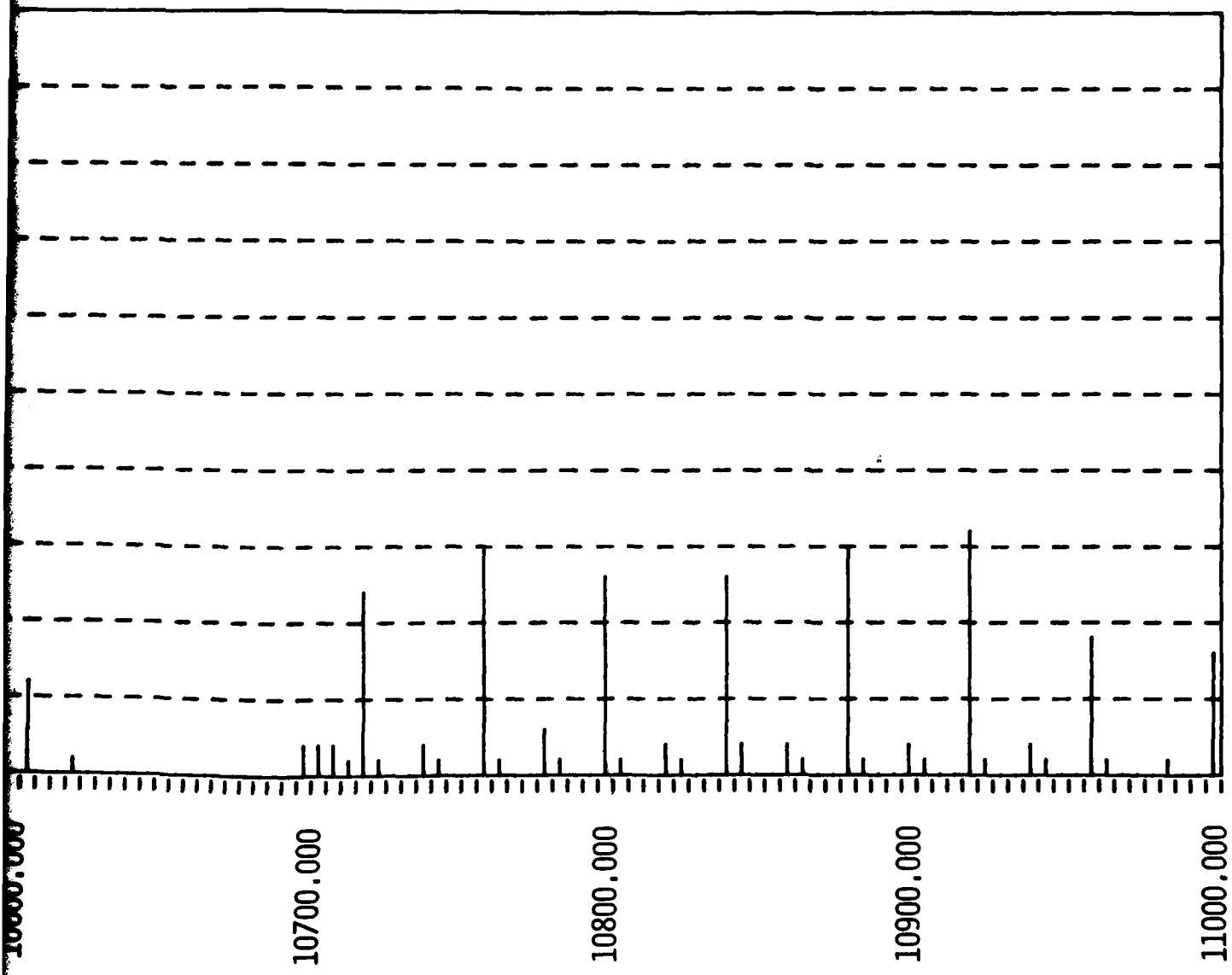


Figure 5.1

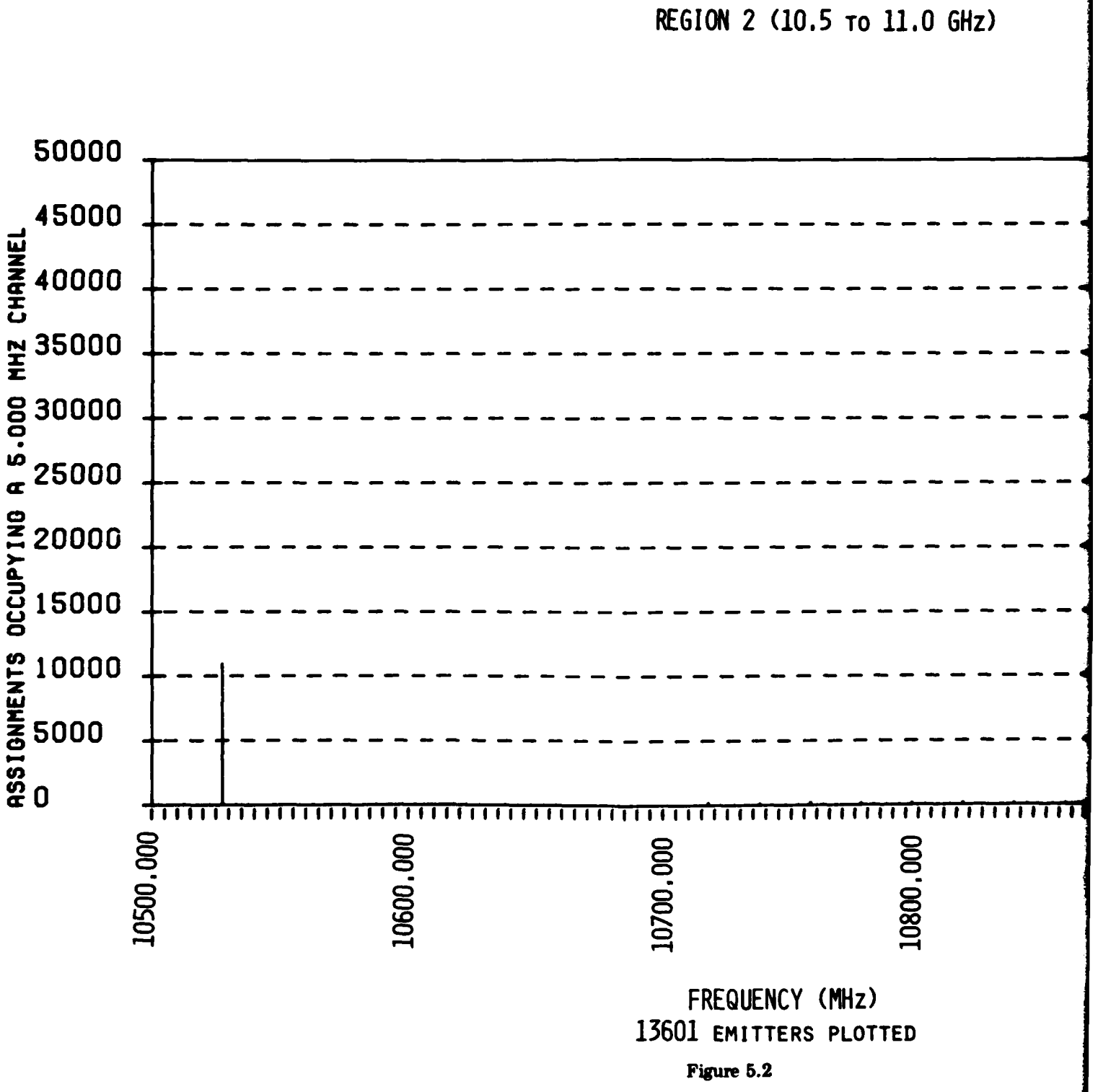

REGION 2 (10.5 TO 11.0 GHz)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
ASSIGNMENTS OCCUPYING A 5.000 MHZ CHANNEL
10500.000
10600.000
10700.000
10800.000
FREQUENCY (MHz)
13601 EMITTERS PLOTTED

Figure 5.2

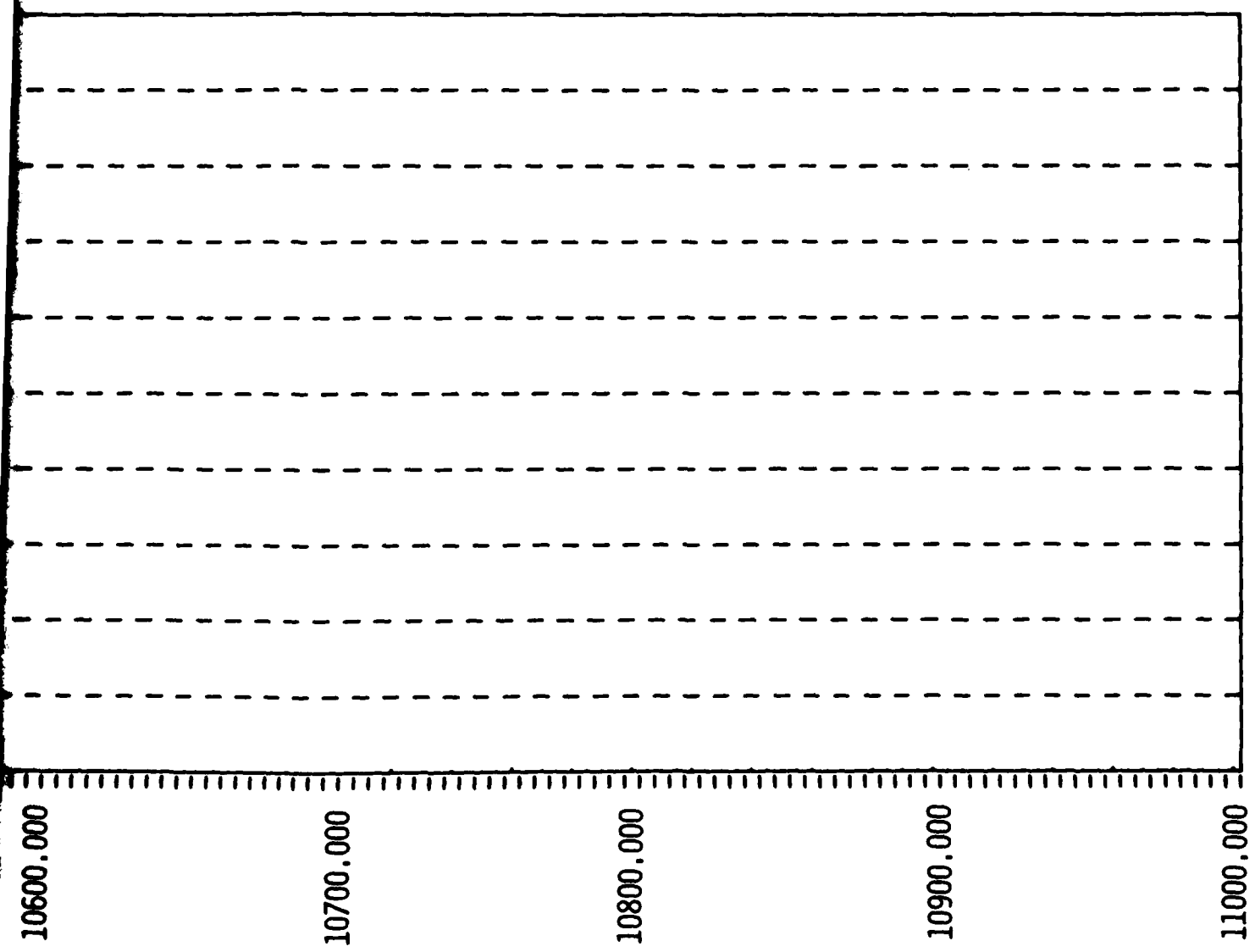

REGION 2 (10.5 TO 11.0 GHz)
10600.000
10700.000
10800.000
10900.000
11000.000
FREQUENCY (MHz)
13601 EMITTERS PLOTTED

Figure 5.2

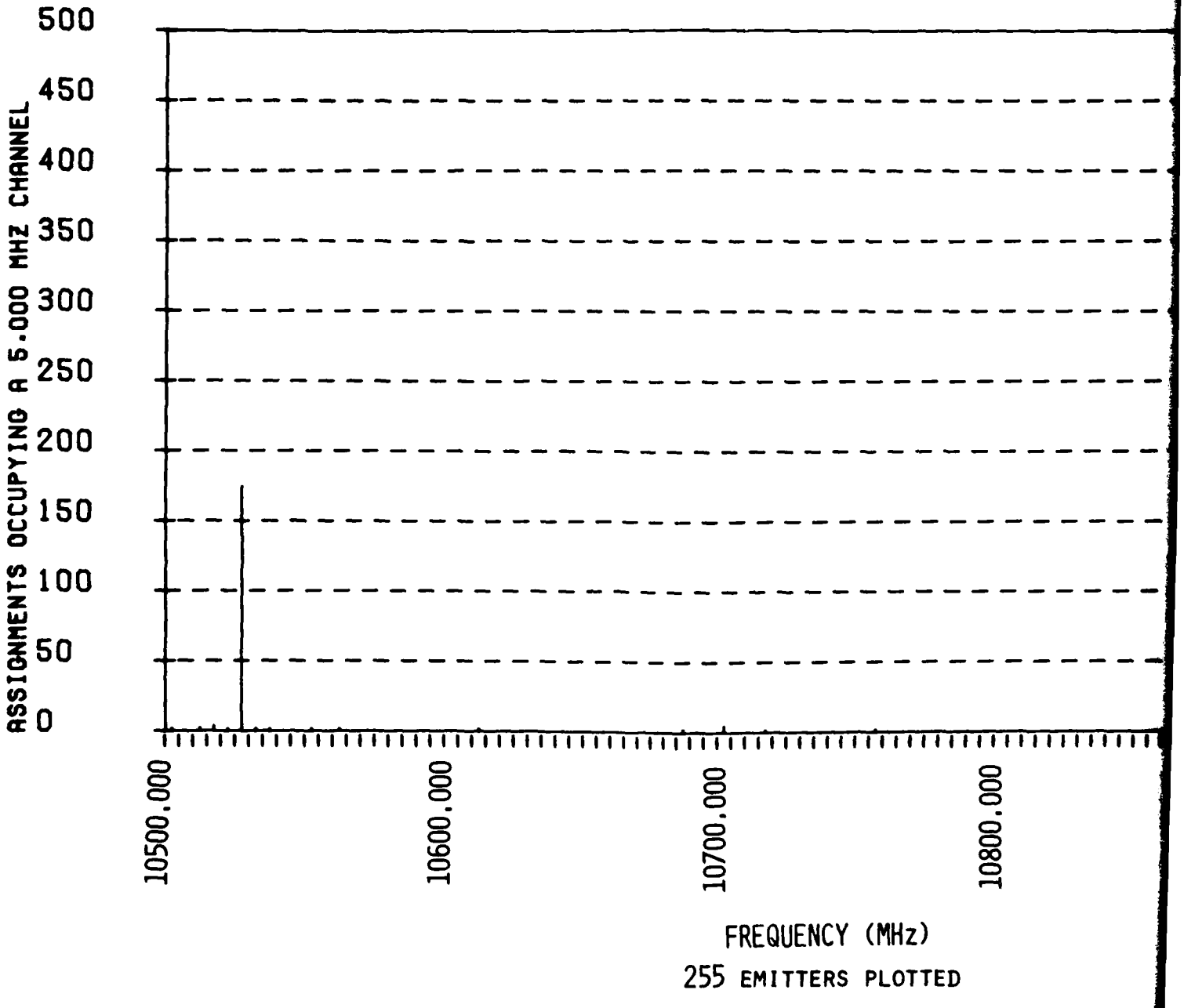

REGION 3 (10.5 TO 11.0 GHz)
ASSIGNMENTS OCCUPYING A 5.000 MHZ CHANNEL
500
450
400
350
300
250
200
150
100
50
0
10500.000
10600.000
10700.000
10800.000
FREQUENCY (MHz)
255 EMITTERS PLOTTED

Figure 5.3

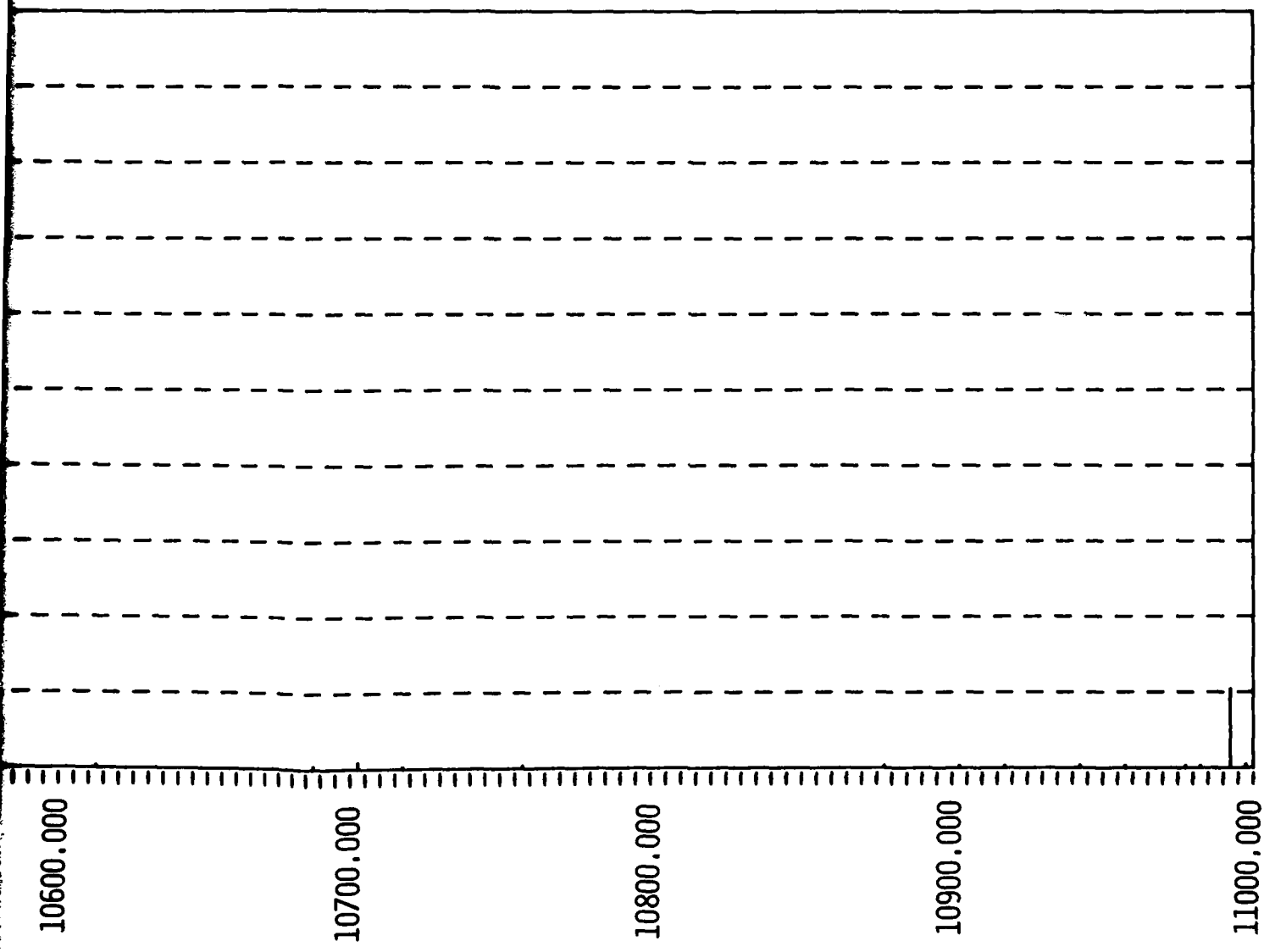

REGION 3 (10.5 TO 11.0 GHz)
10600.000
10700.000
10800.000
10900.000
11000.000
FREQUENCY (MHz)
255 EMITTERS PLOTTED

Figure 5.3

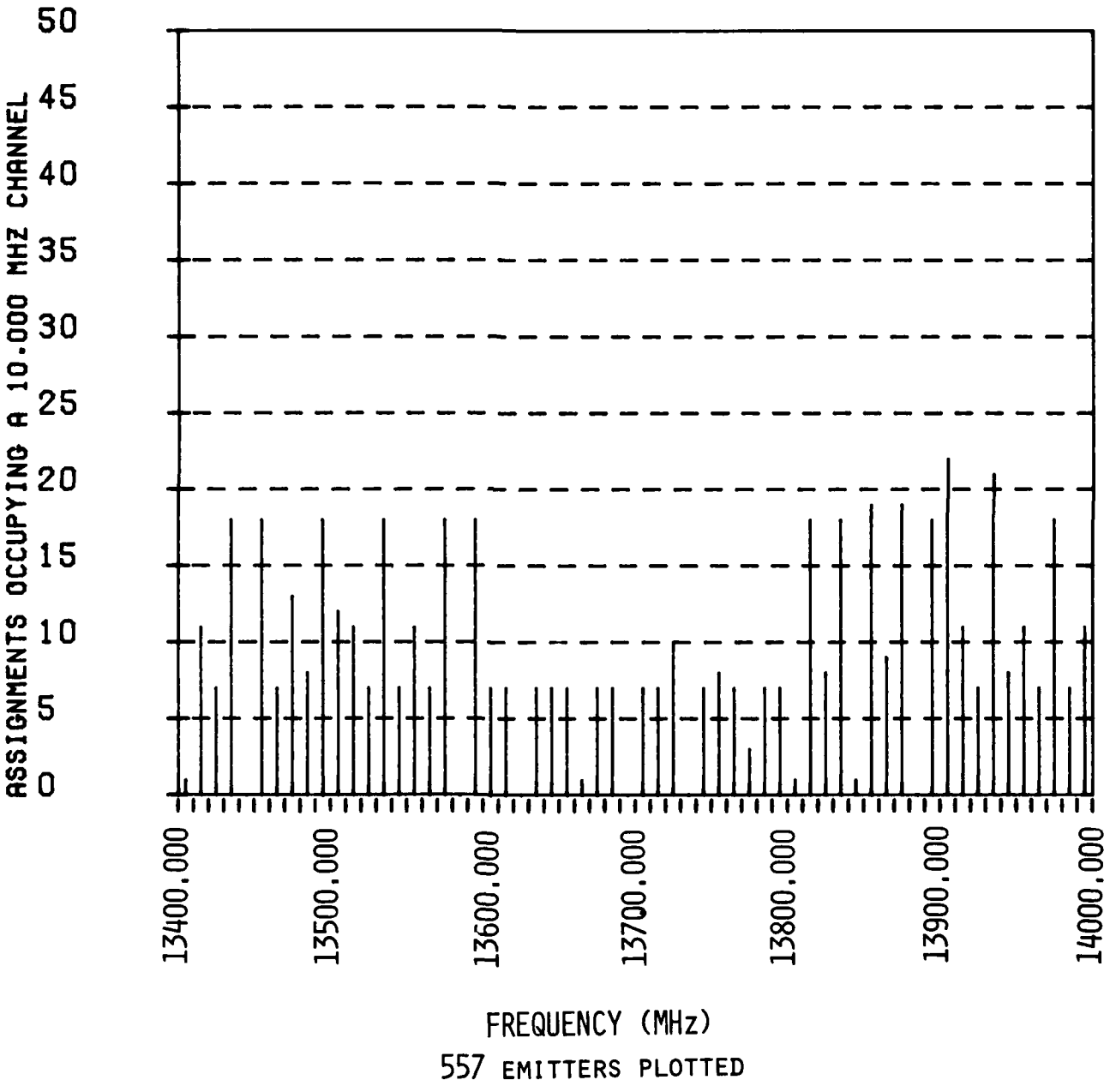

WORLD (13.4 TO 14.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
13400.000
13500.000
13600.000
13700.000
13800.000
13900.000
14000.000
FREQUENCY (MHz)
557 EMITTERS PLOTTED

Figure 6

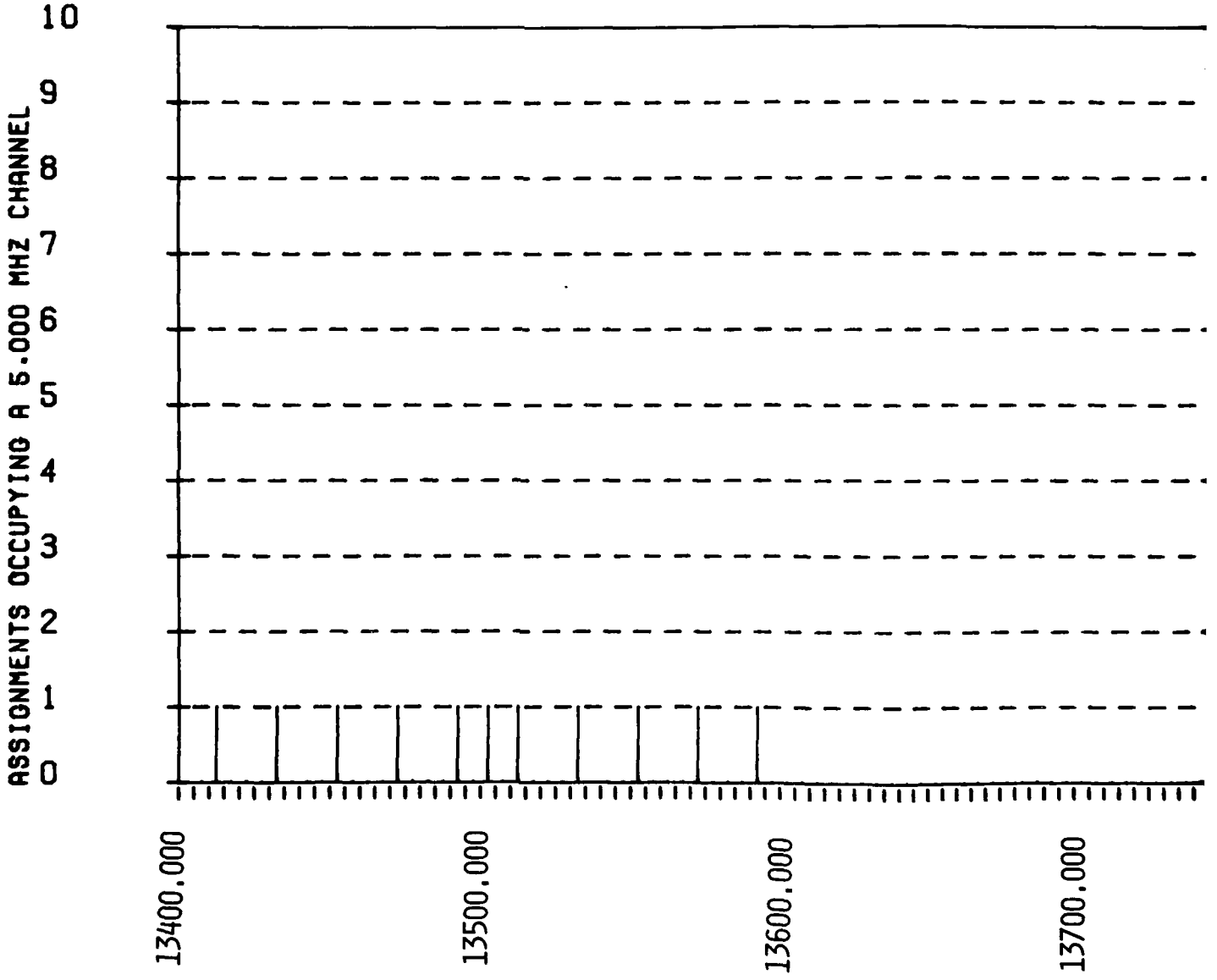

REGION 1 (13.4 TO 14.0 GHz)
ASSIGNMENTS OCCUPYING A 5.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
13400.000
13500.000
13600.000
13700.000
FREQUENCY (MHz)
23 EMITTERS PLOTTED

Figure 6.1

REGION 1 (13.4 TO 14.0 GHz)

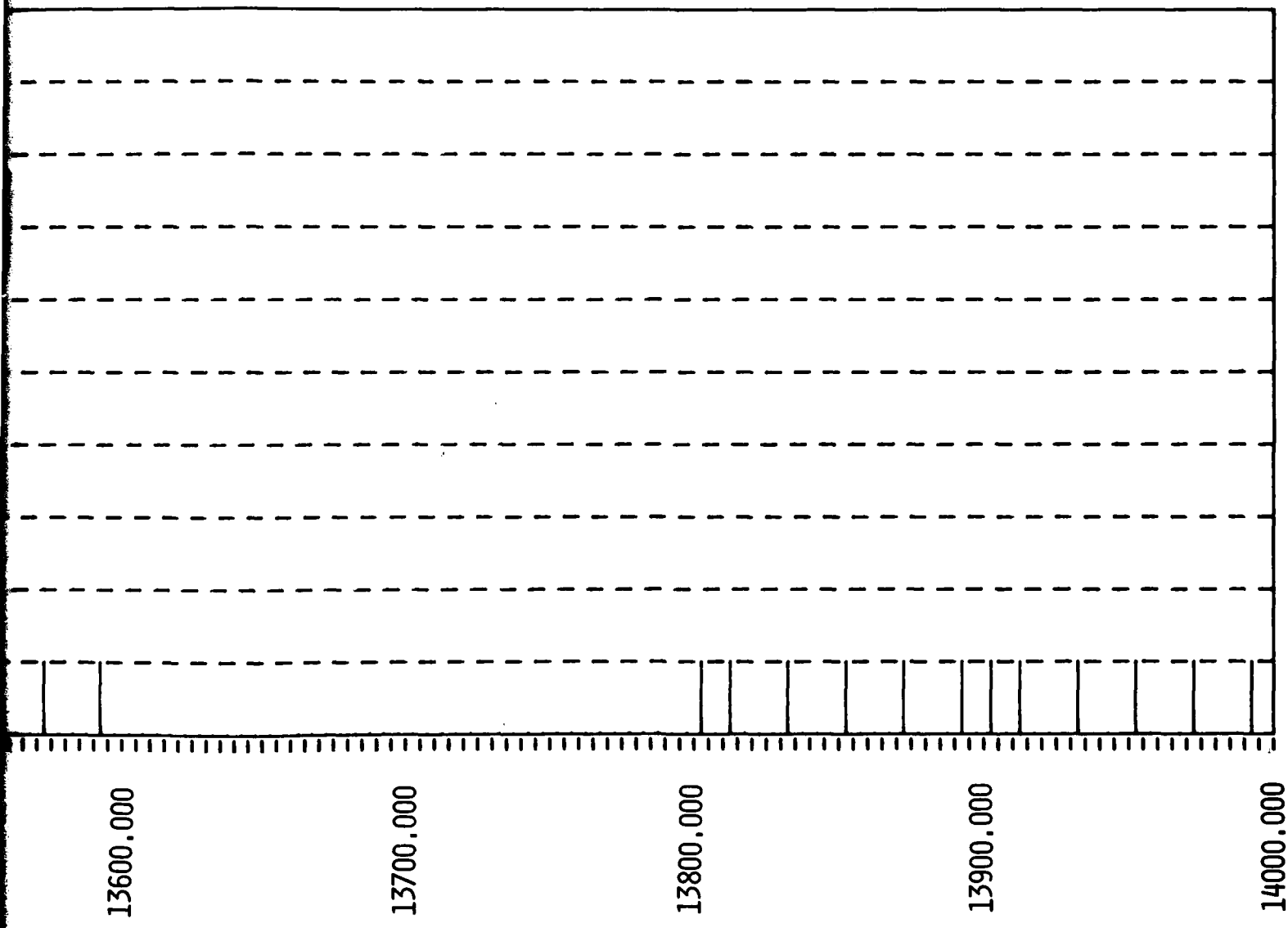


Figure 6.1

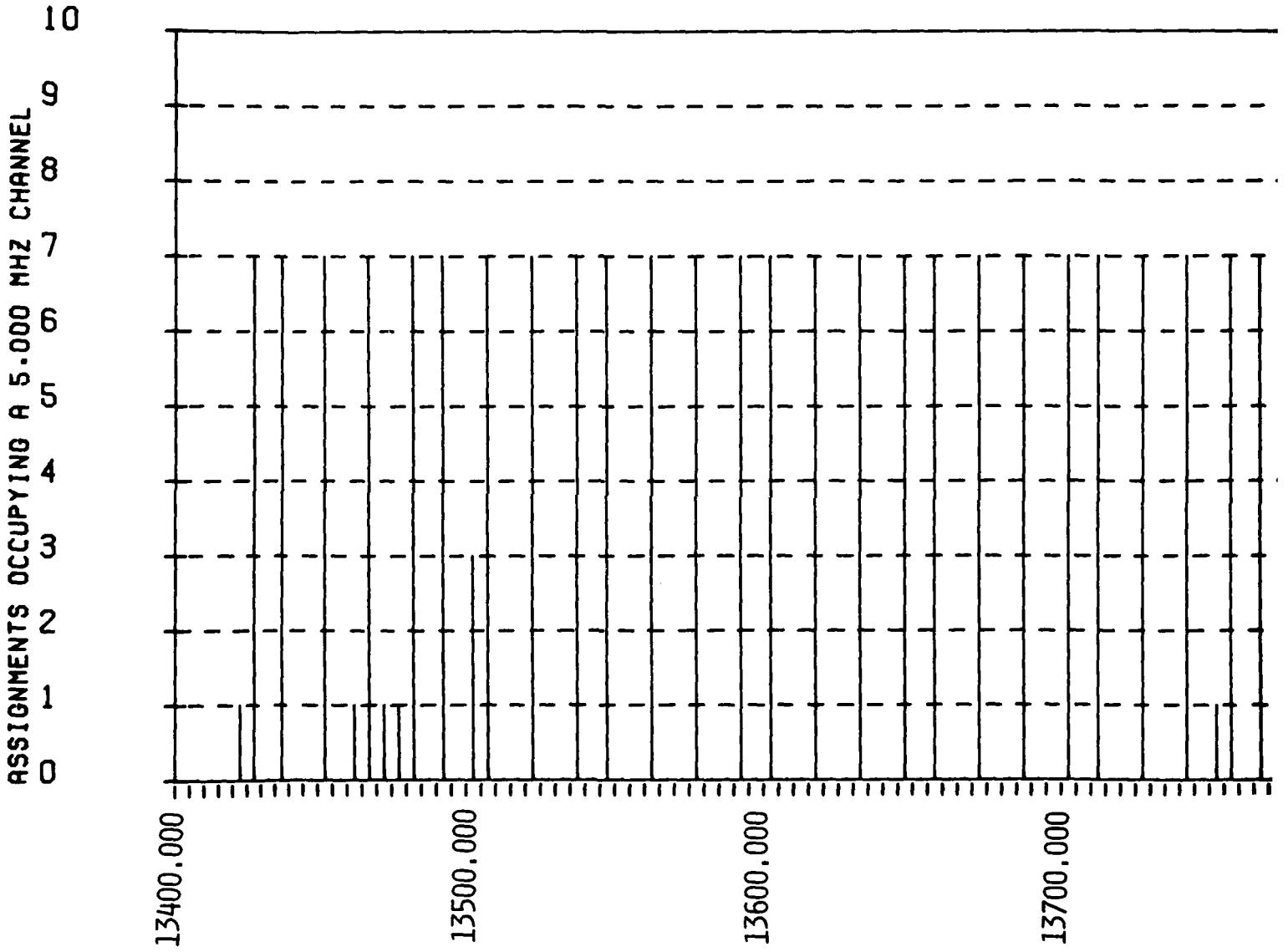

REGION 2 (13.4 TO 14.0 GHz)
ASSIGNMENTS OCCUPYING A 5.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
13400.000
13500.000
13600.000
13700.000
FREQUENCY (MHz)
320 EMITTERS PLOTTED

Figure 6.2

REGION 2 (13.4 TO 14.0 GHz)

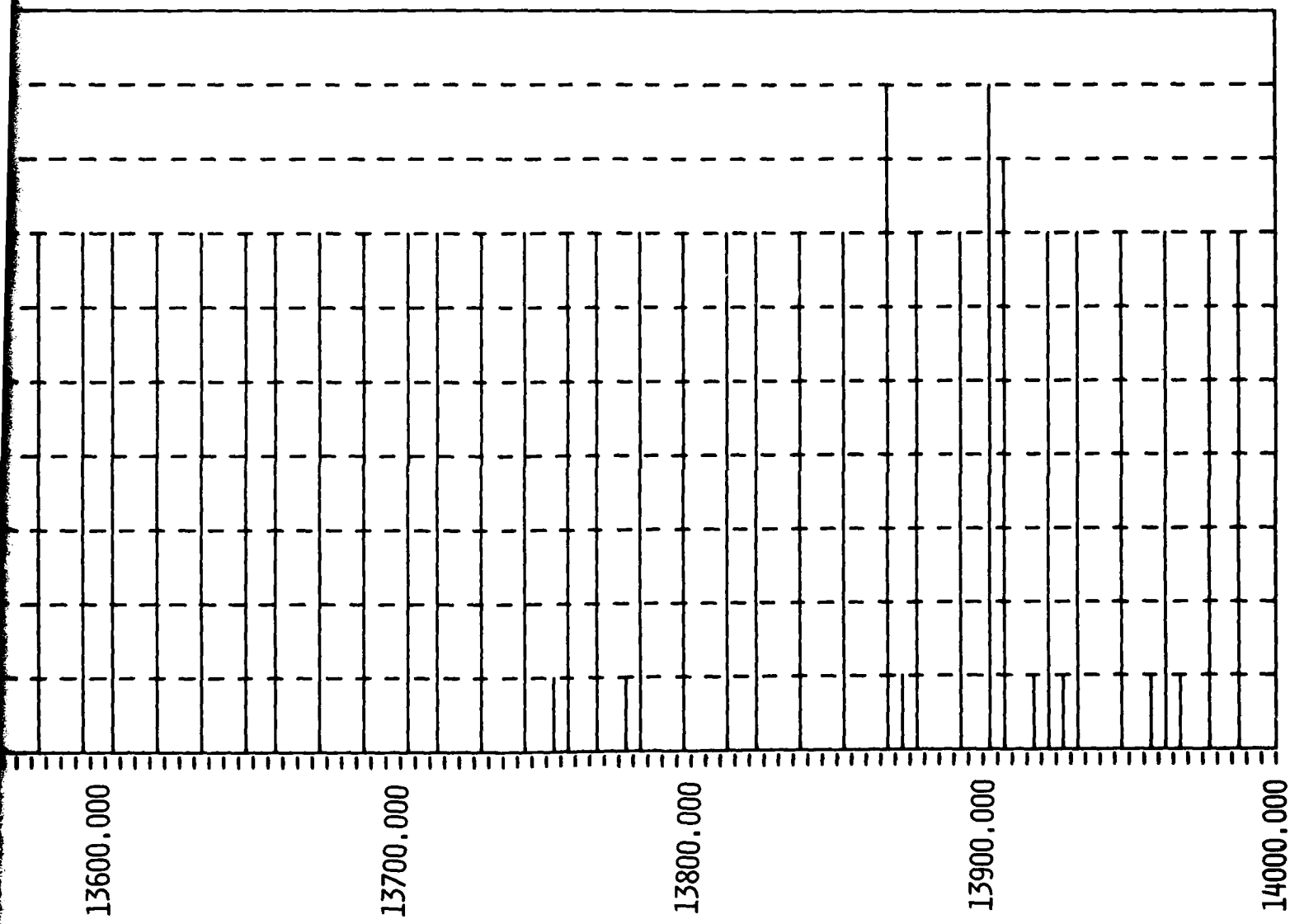
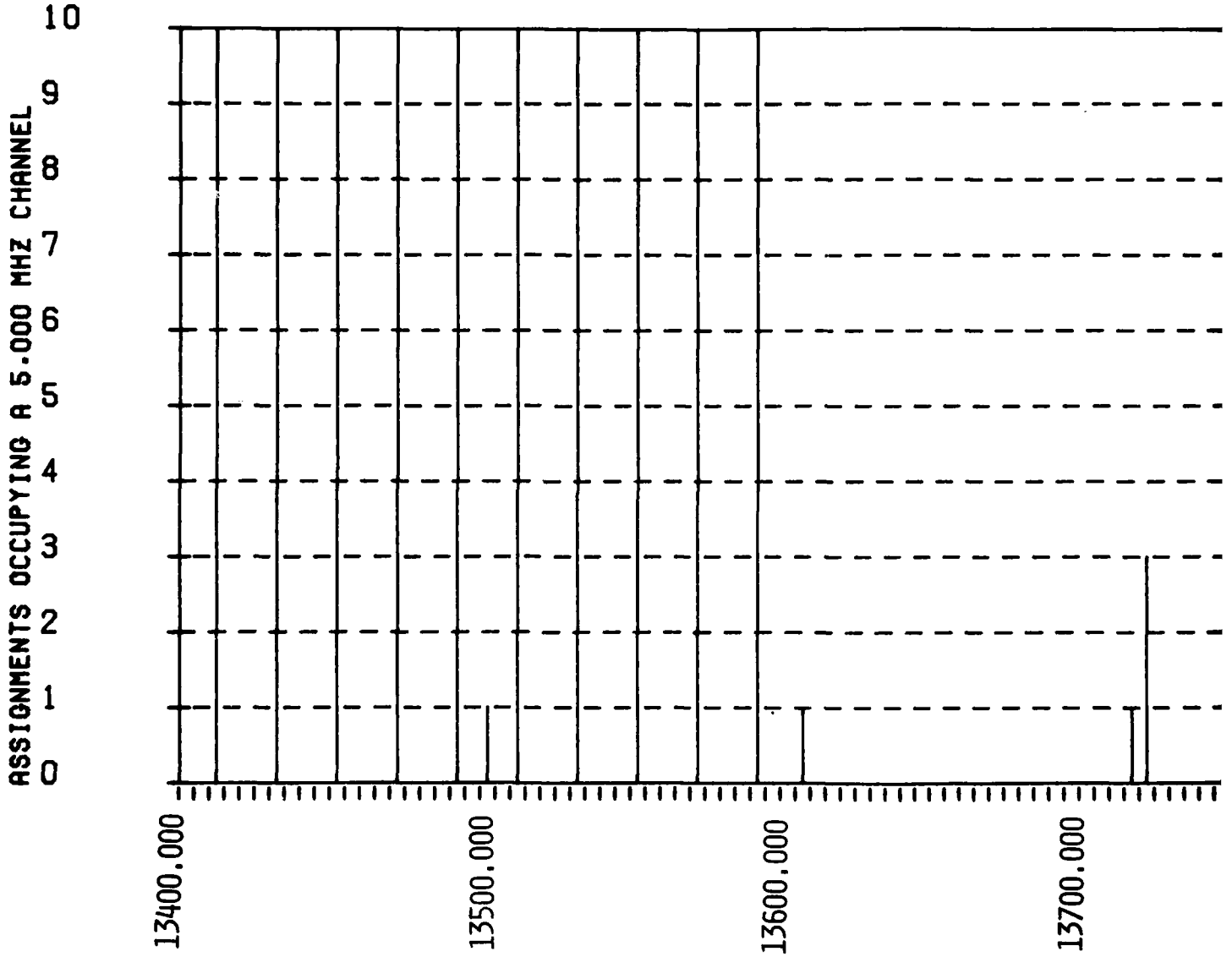


Figure 6.2

REGION 3 (13.4 TO 14.0 GHz)



217 EMITTERS PLOTTED

Figure 6.3

REGION 3 (13.4 TO 14.0 GHz)

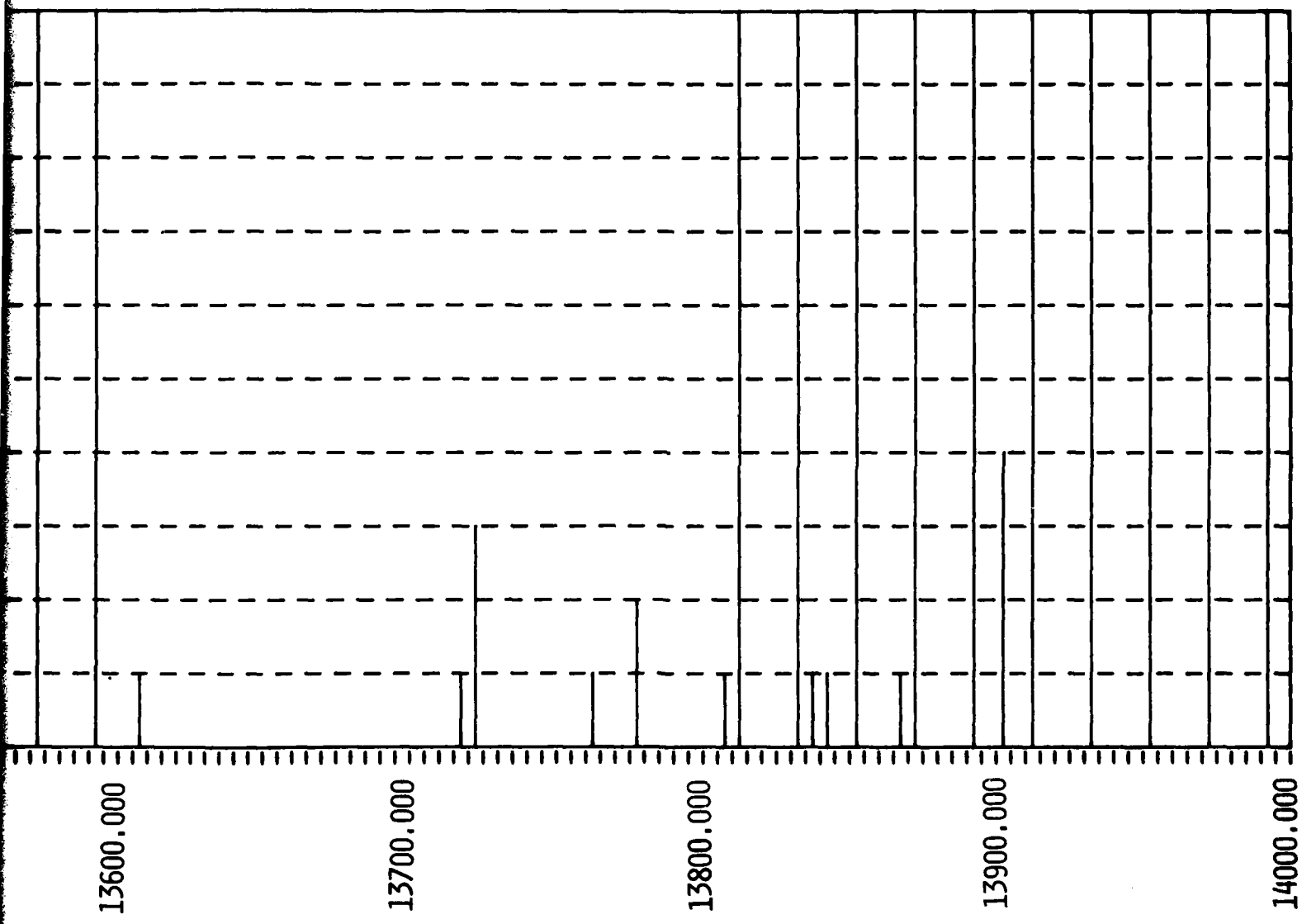


Figure 6.3

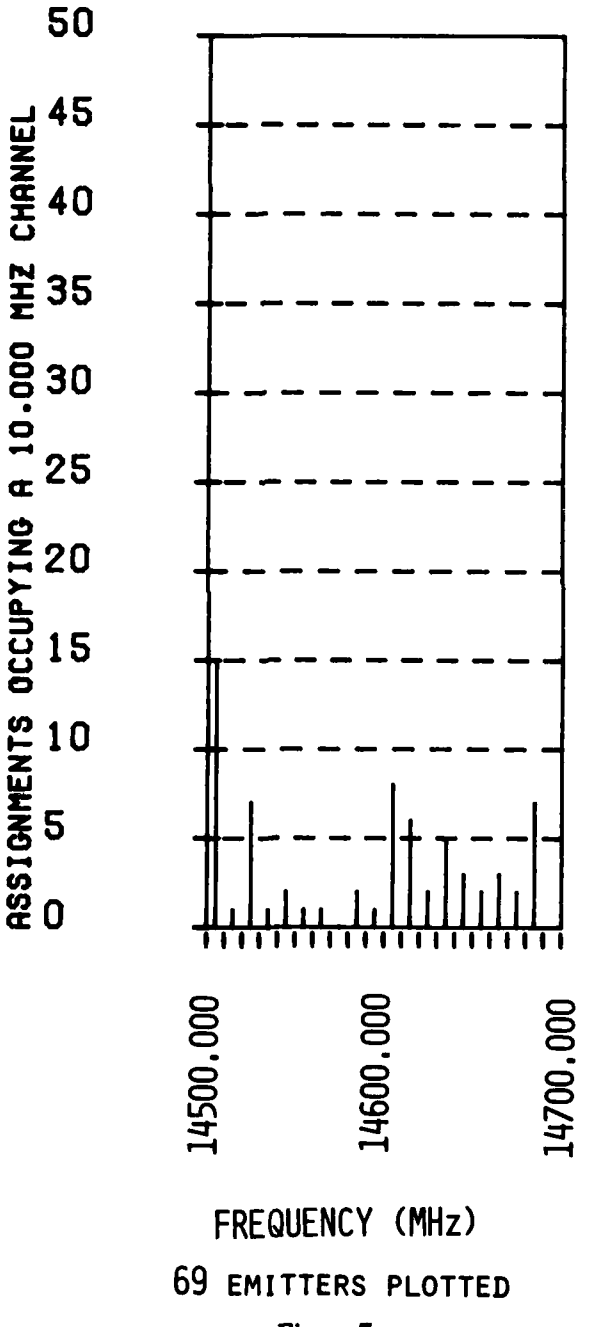
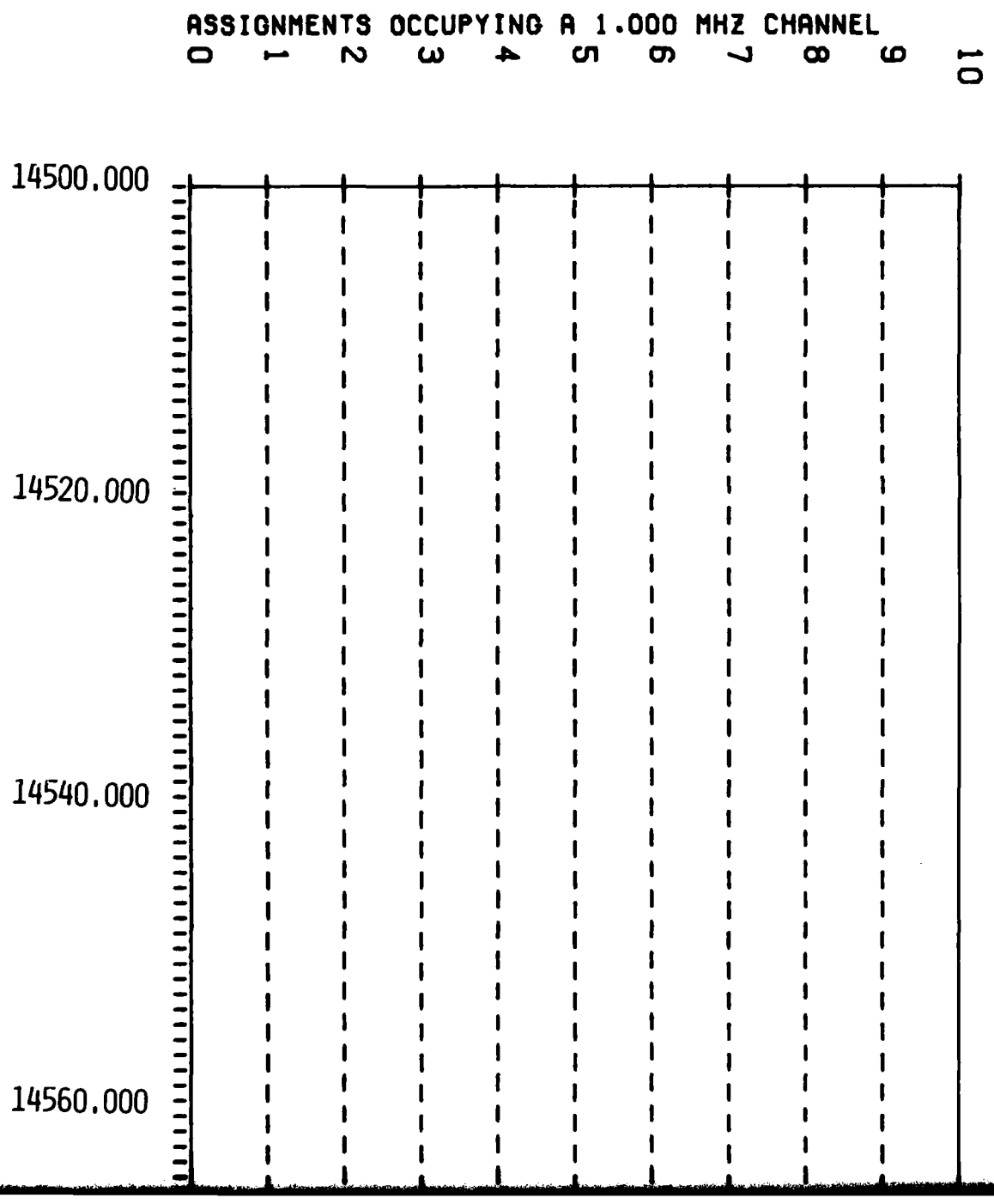

WORLD (14.5 TO 14.7 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
14500.000
14600.000
14700.000
FREQUENCY (MHz)
69 EMITTERS PLOTTED

Figure 7


ASSIGNMENTS OCCUPYING A 1.000 MHZ CHANNEL
0
1
2
3
4
5
6
7
8
9
10
14500.000
14520.000
14540.000
14560.000

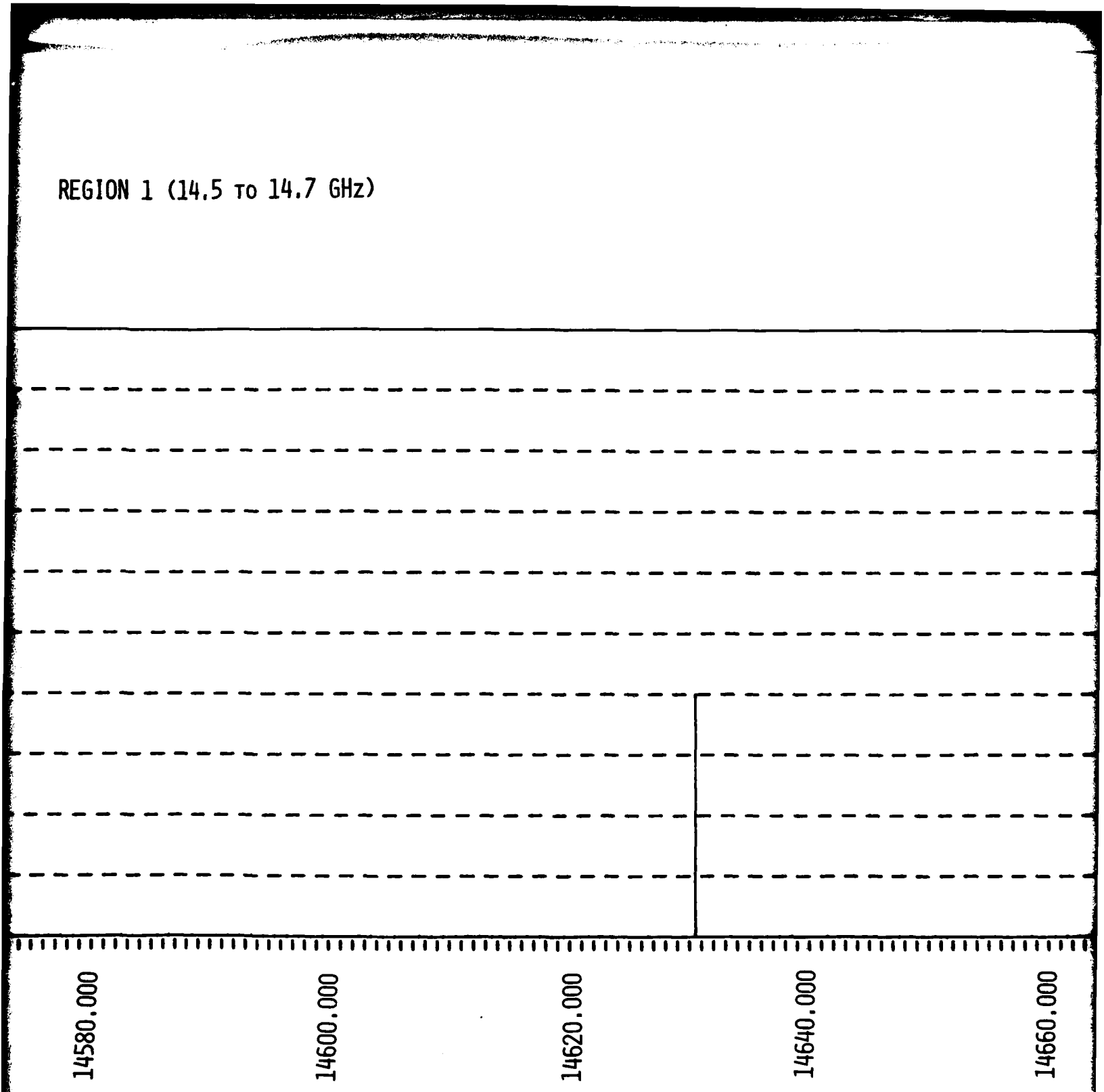
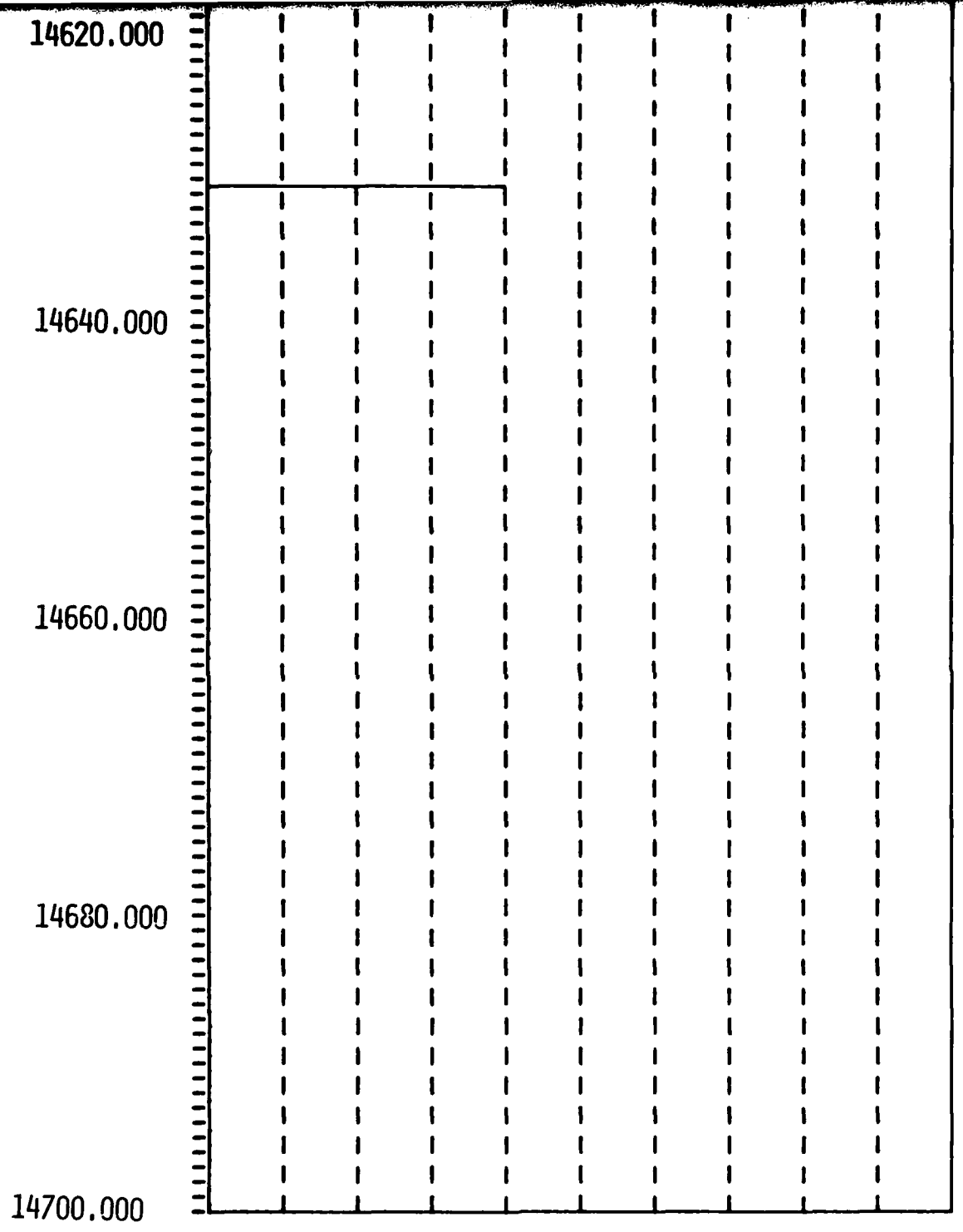
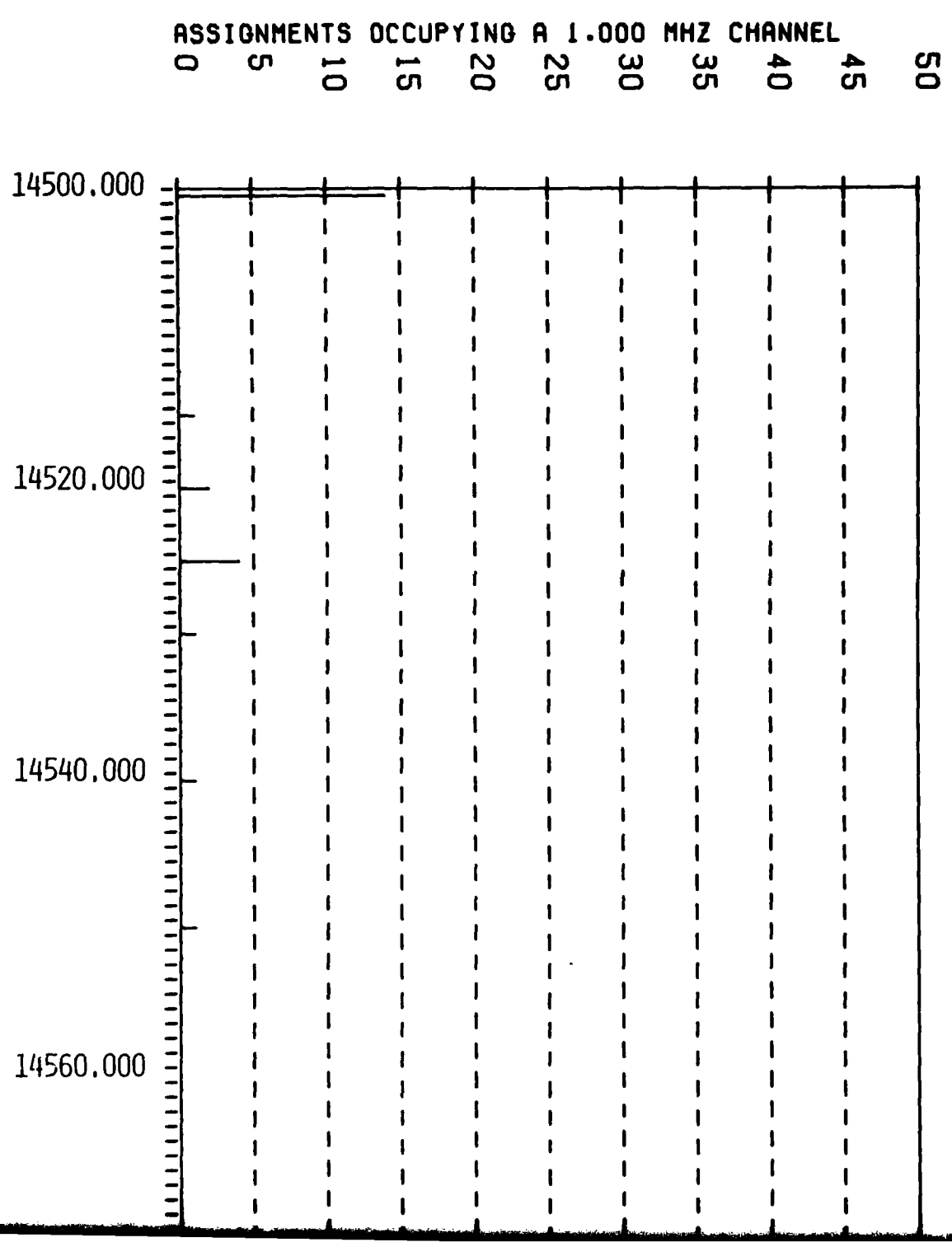

REGION 1 (14.5 TO 14.7 GHz)
14580.000
14600.000
14620.000
14640.000
14660.000
FREQUENCY (MHz)
4 EMITTERS PLOTTED

Figure 7.1


14620.000
14640.000
14660.000
14680.000
14700.000


ASSIGNMENTS OCCUPYING A 1.000 MHZ CHANNEL
0
5
10
15
20
25
30
35
40
45
50
14500.000
14520.000
14540.000
14560.000

GION 2 (14.5 TO 14.7 GHz)

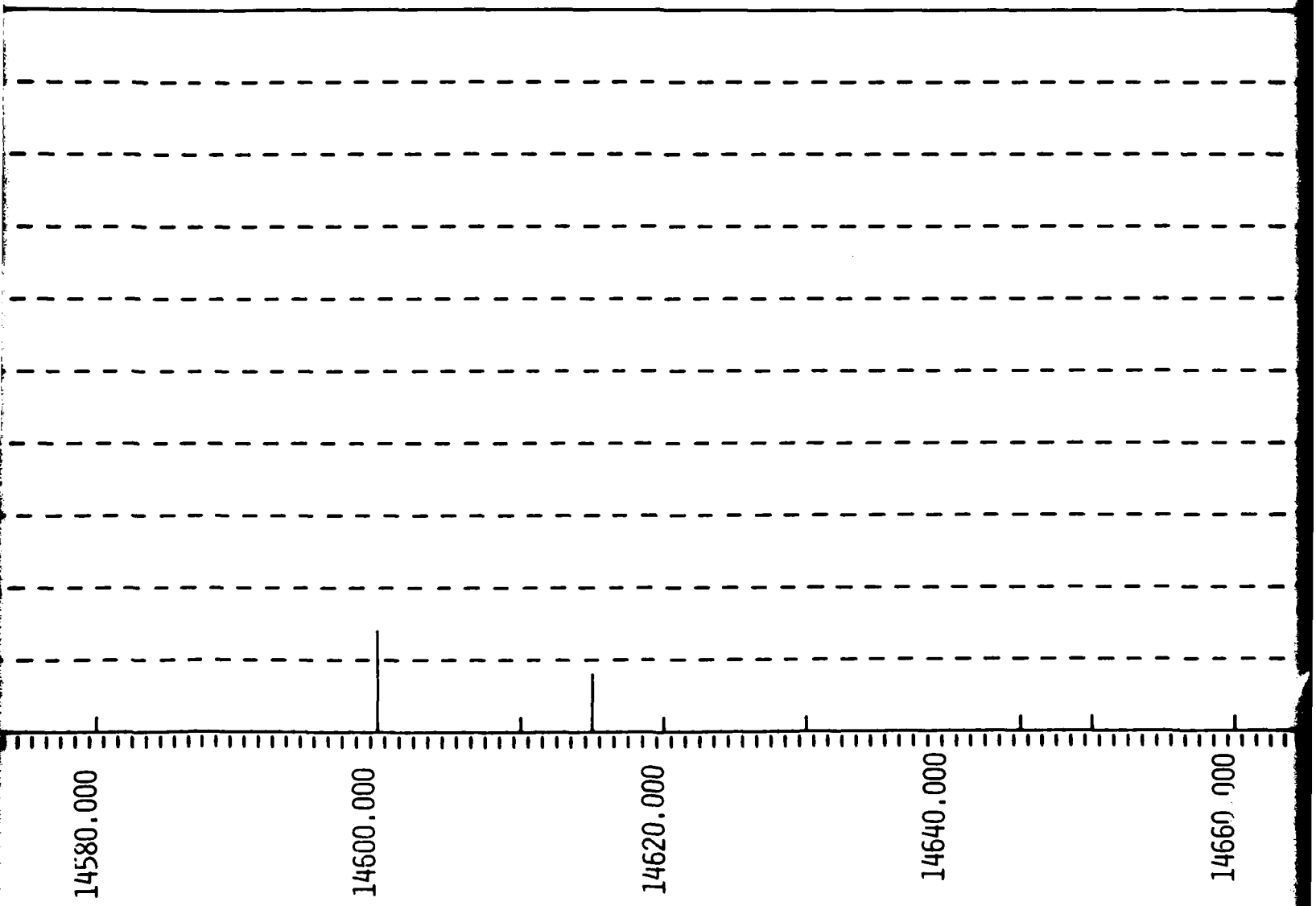
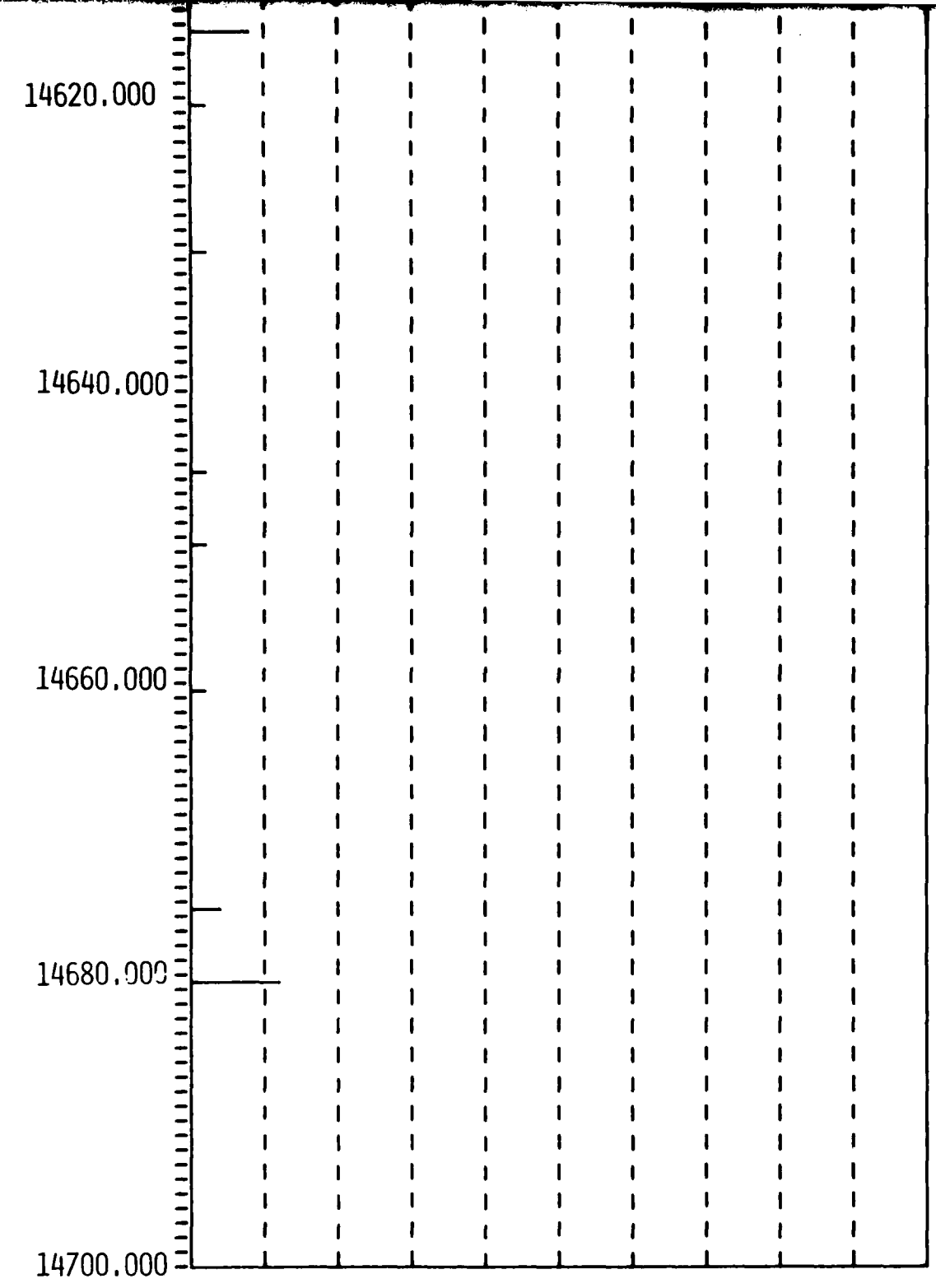
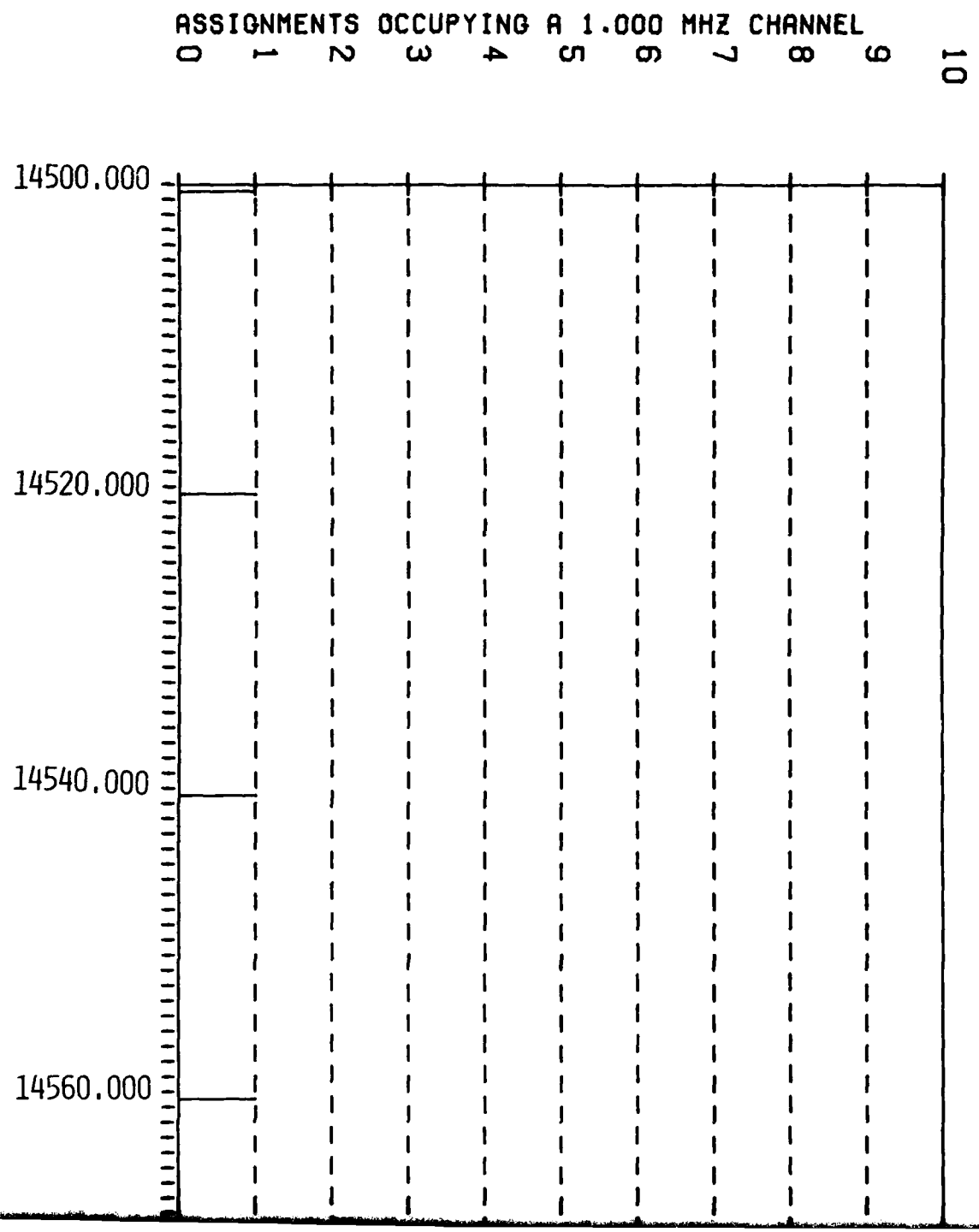


Figure 7.2


14620.000
14640.000
14660.000
14680.000
14700.000


ASSIGNMENTS OCCUPYING A 1.000 MHZ CHANNEL
0
1
2
3
4
5
6
7
8
9
10
14500.000
14520.000
14540.000
14560.000

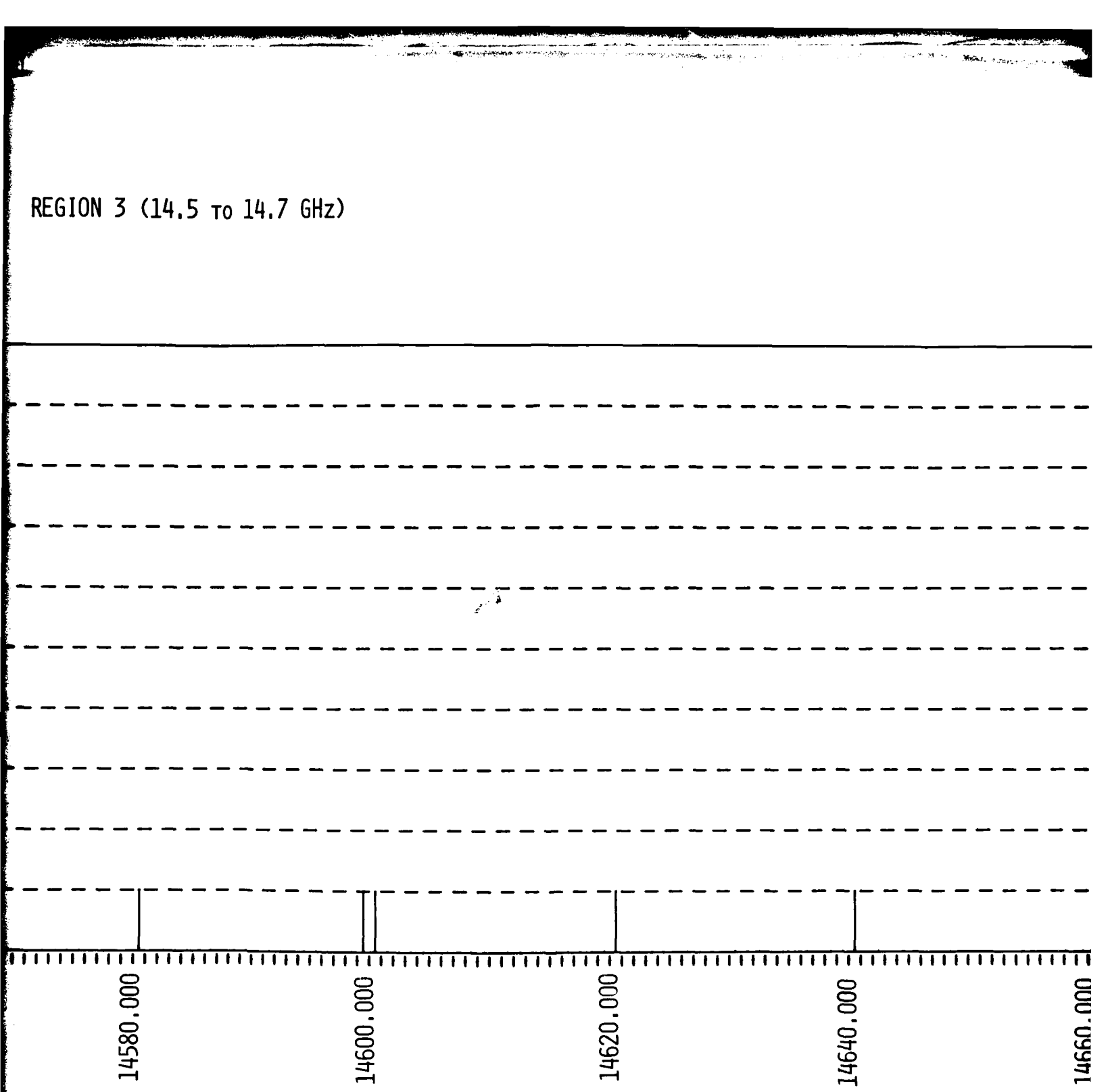
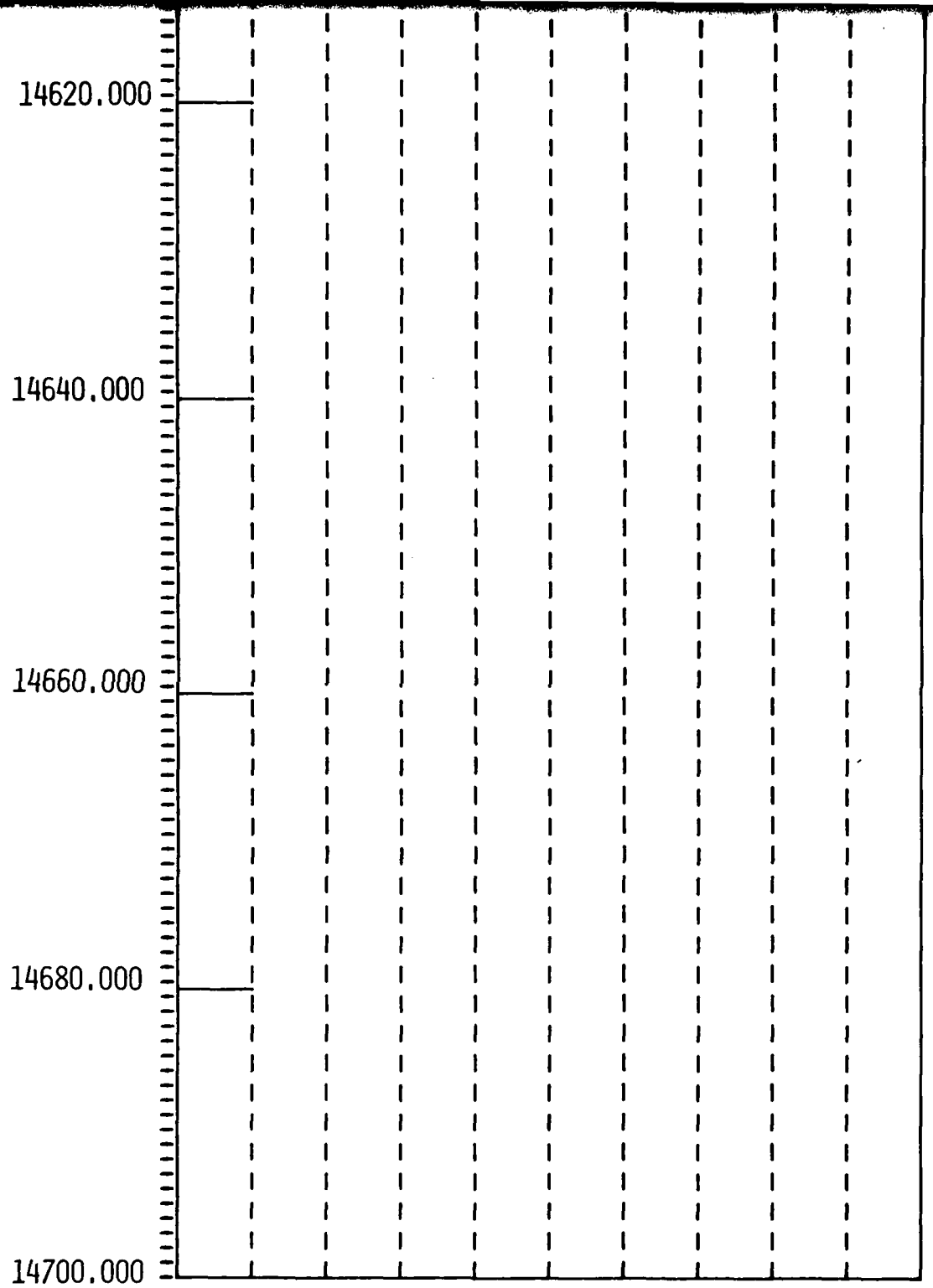
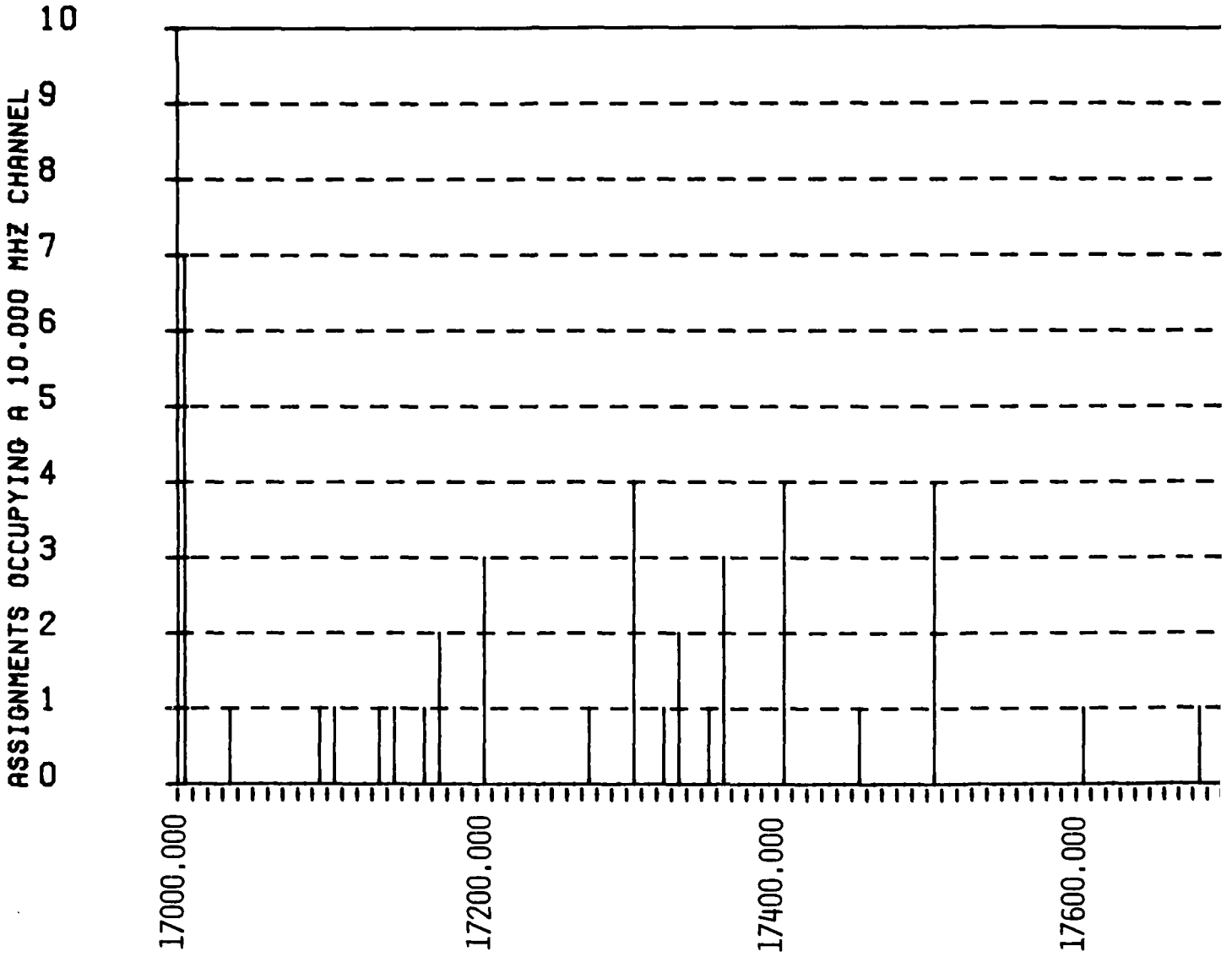

REGION 3 (14.5 TO 14.7 GHz)
14580.000
14600.000
14620.000
14640.000
14660.000
FREQUENCY (MHz)
11 EMITTERS PLOTTED

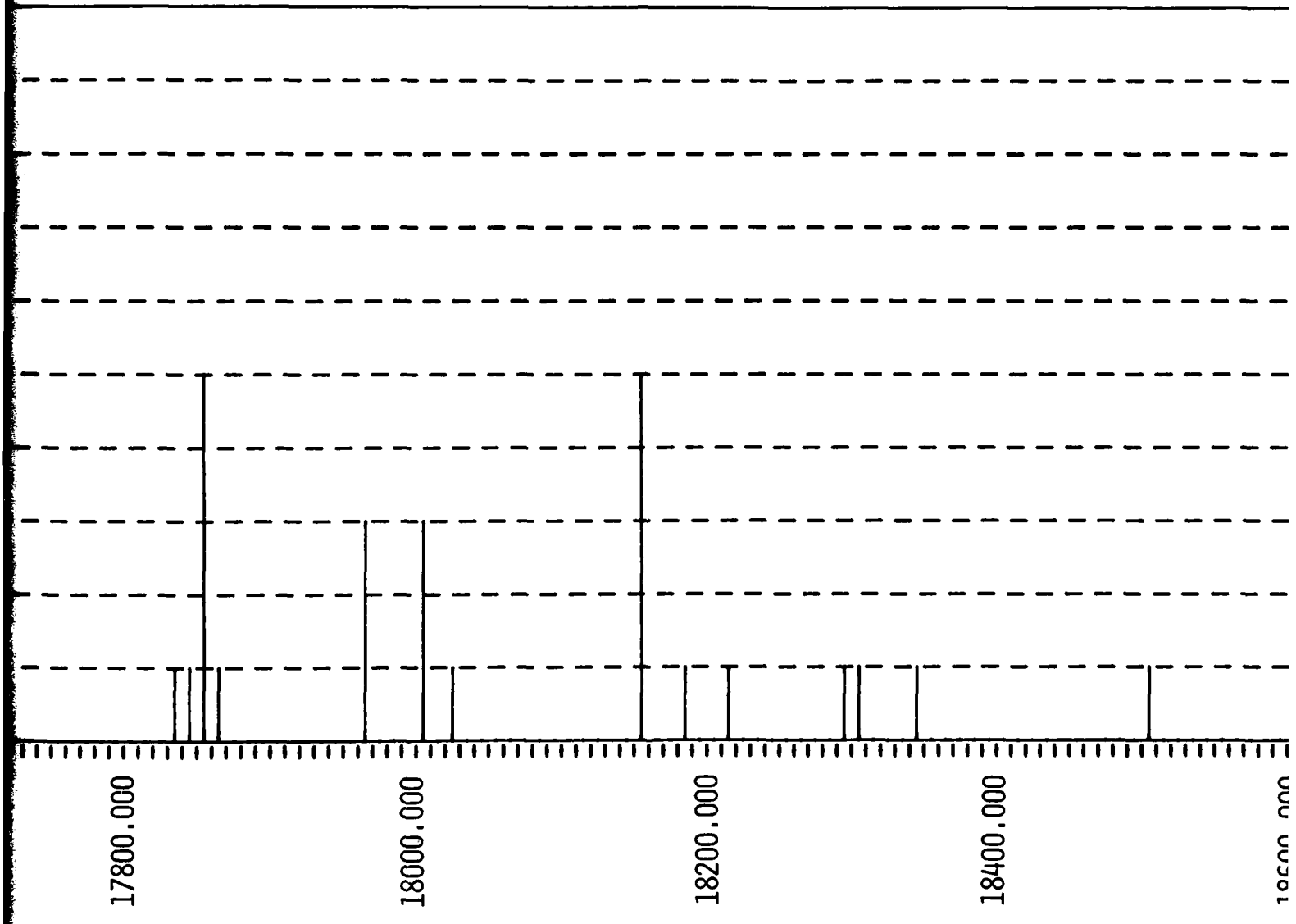
Figure 7.3


14620.000
14640.000
14660.000
14680.000
14700.000

WORLD


ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
17000.000
17200.000
17400.000
17600.000

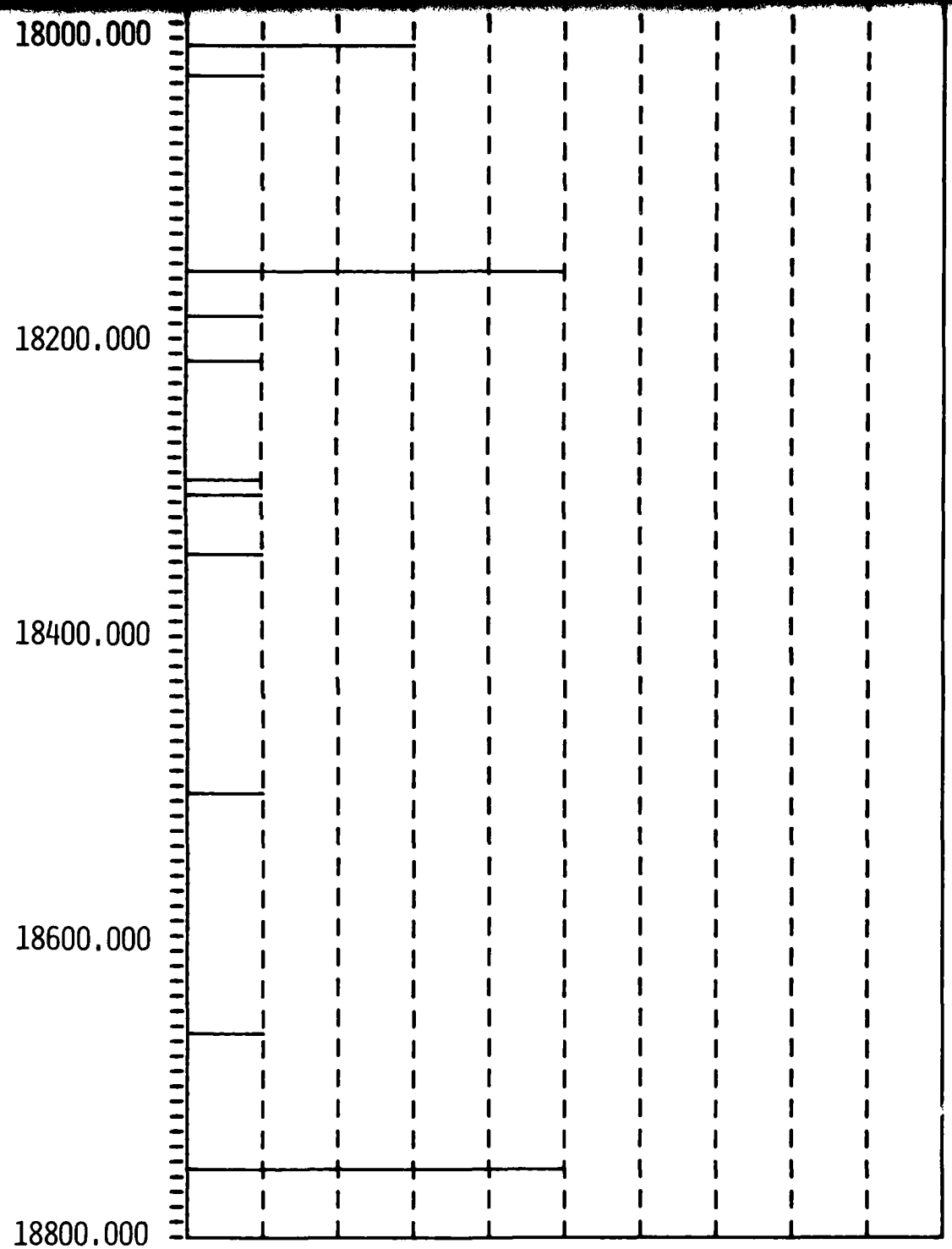
(17.0 TO 18.8 GHZ)



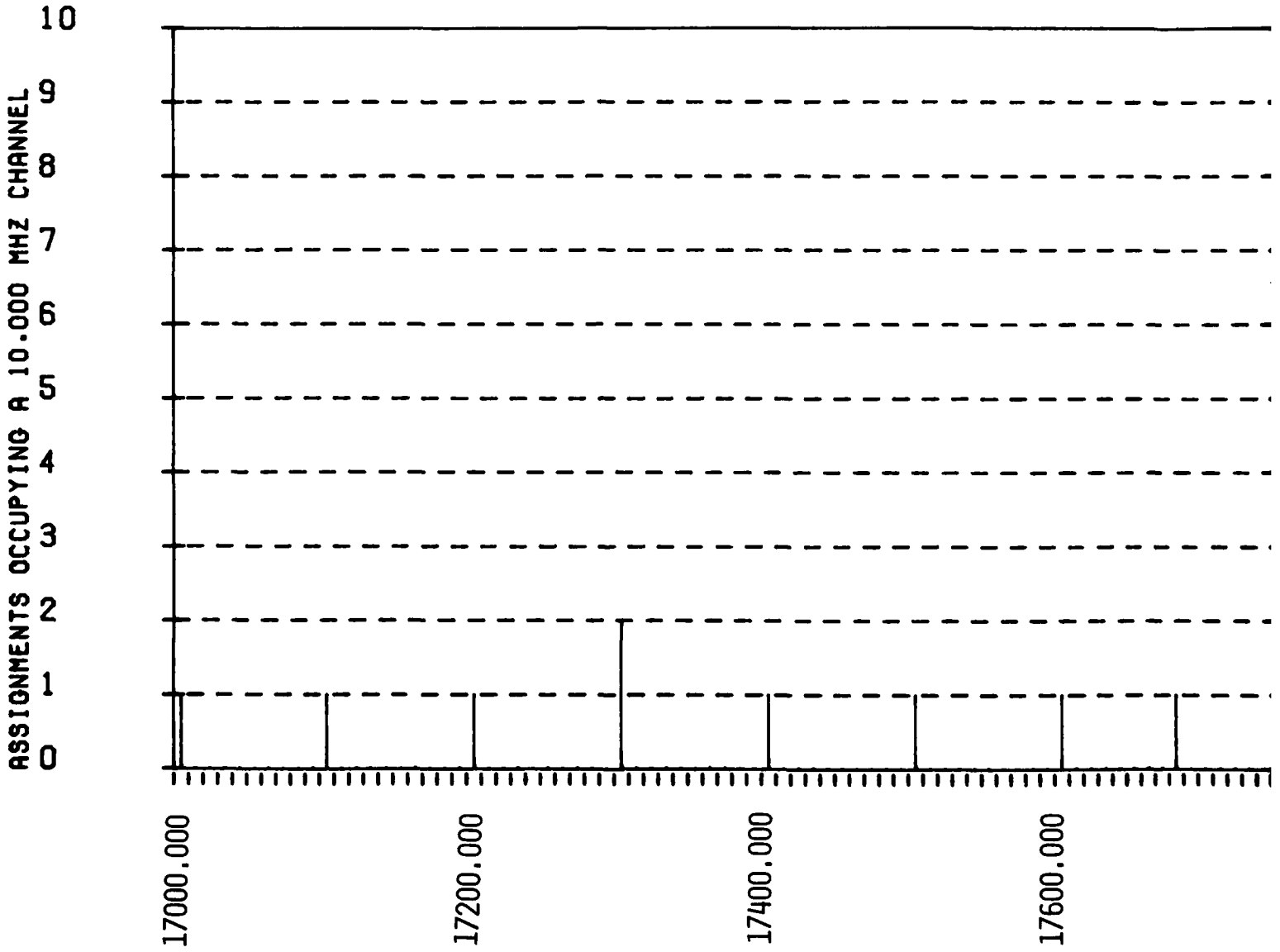
FREQUENCY (MHz)

77 EMITTERS PLOTTED

Figure 8


18000.000
18200.000
18400.000
18600.000
18800.000

WORLD (17.0 TO



9 E

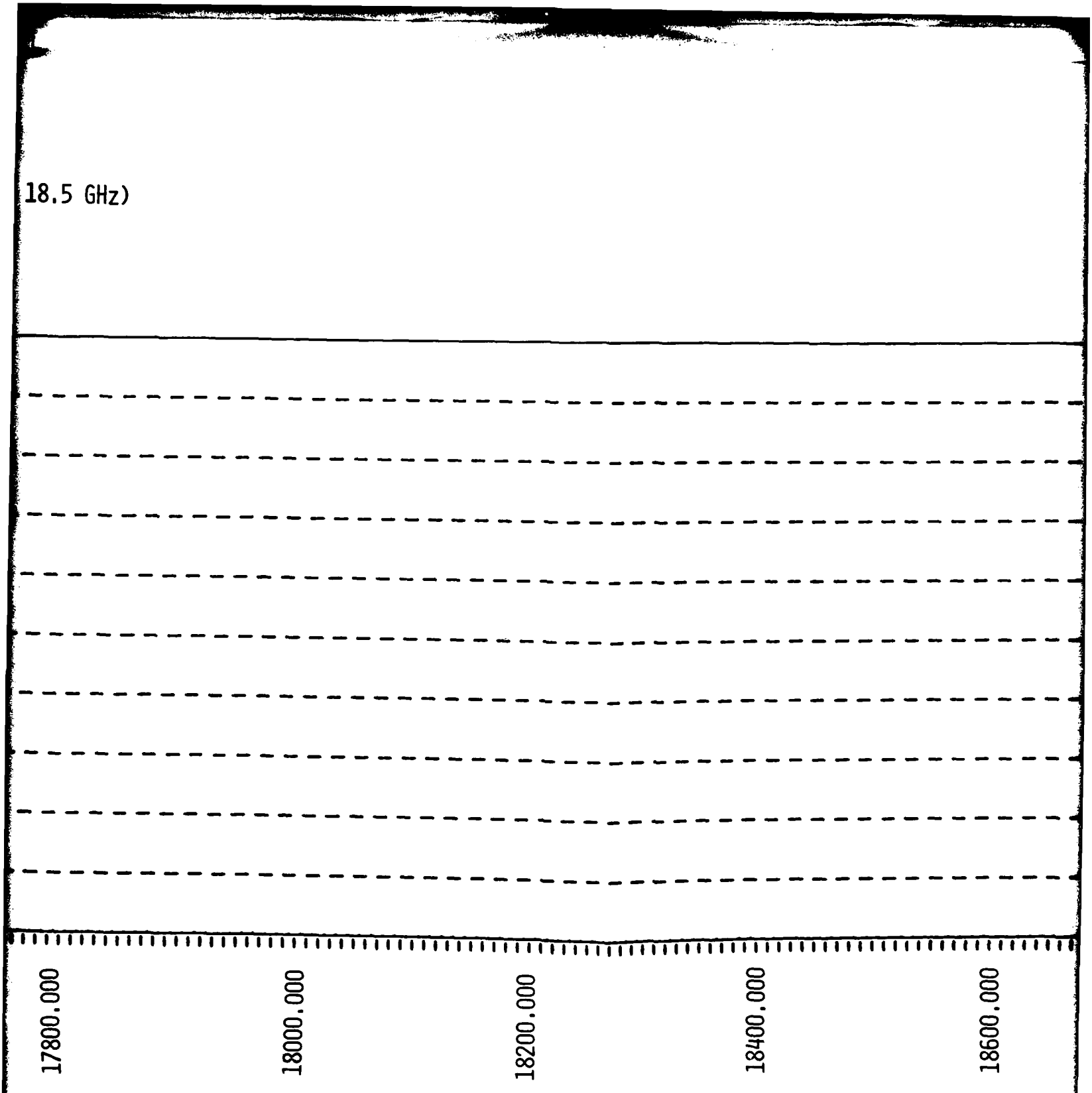
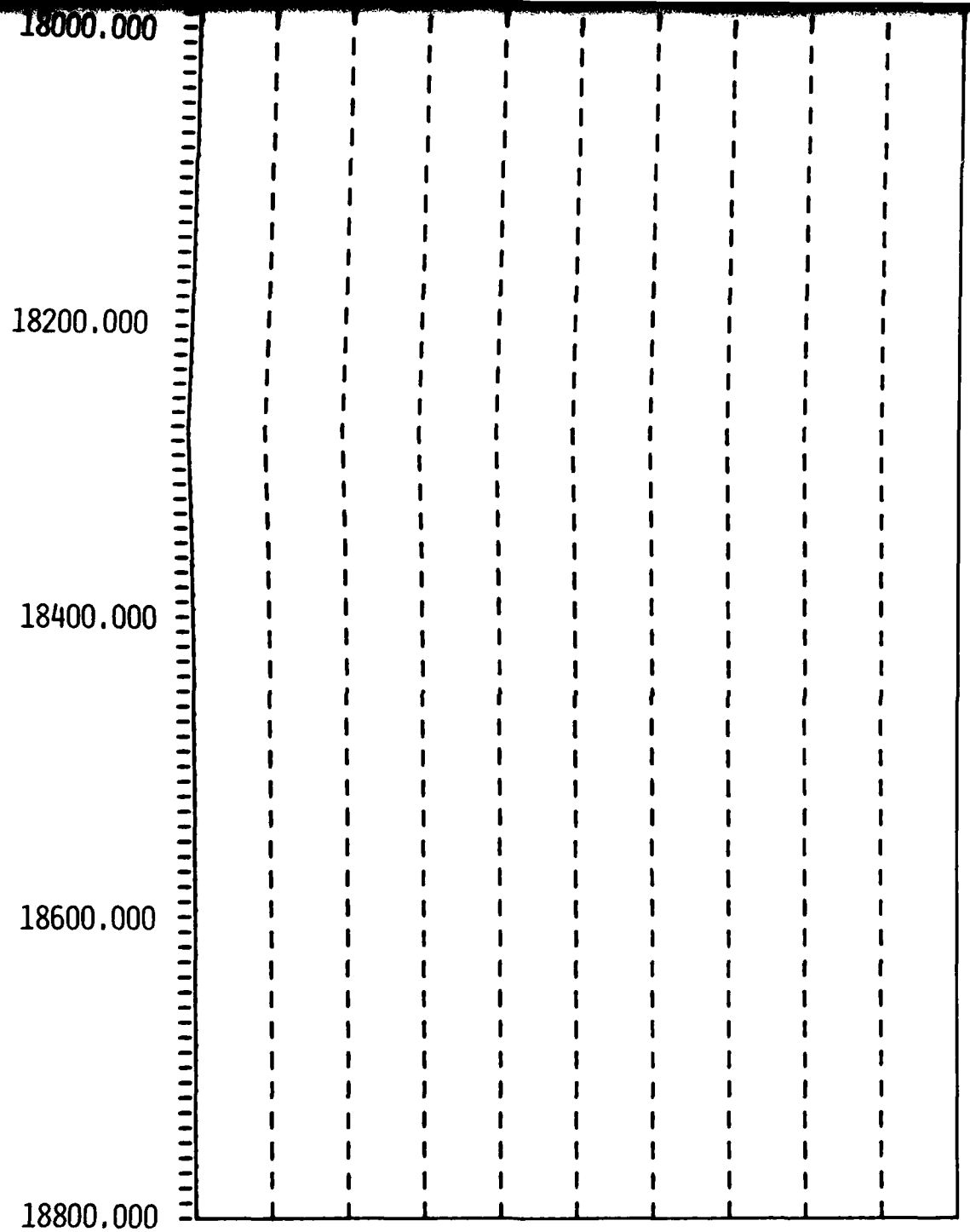
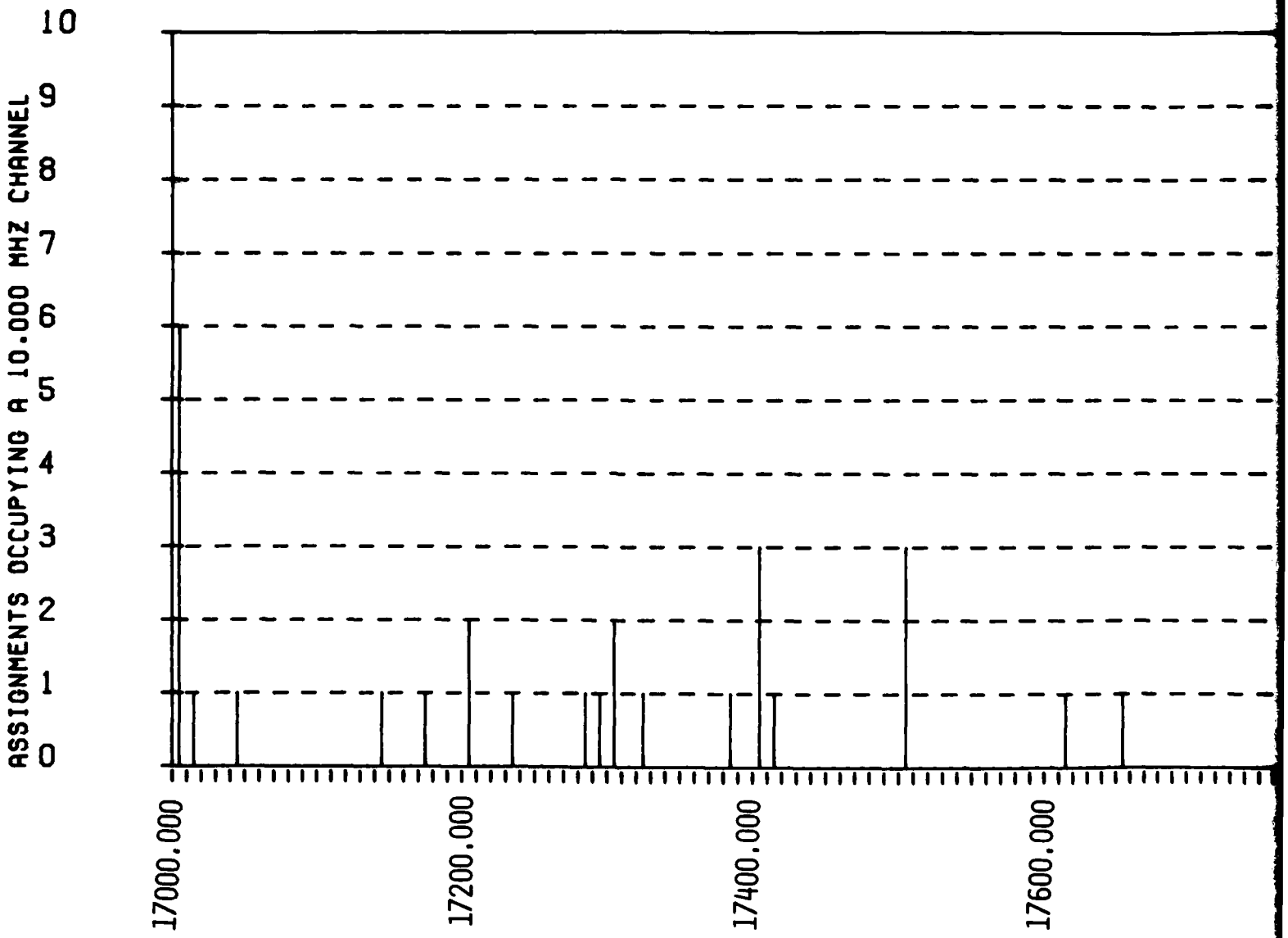

18.5 GHz)
17800.000
18000.000
18200.000
18400.000
18600.000
REQUENCY (MHz)
ITTERS PLOTTED

Figure 8.1


18000.000
18200.000
18400.000
18600.000
18800.000

REGION 2 (17.0


ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
17000.000
17200.000
17400.000
17600.000

18.8 GHz)

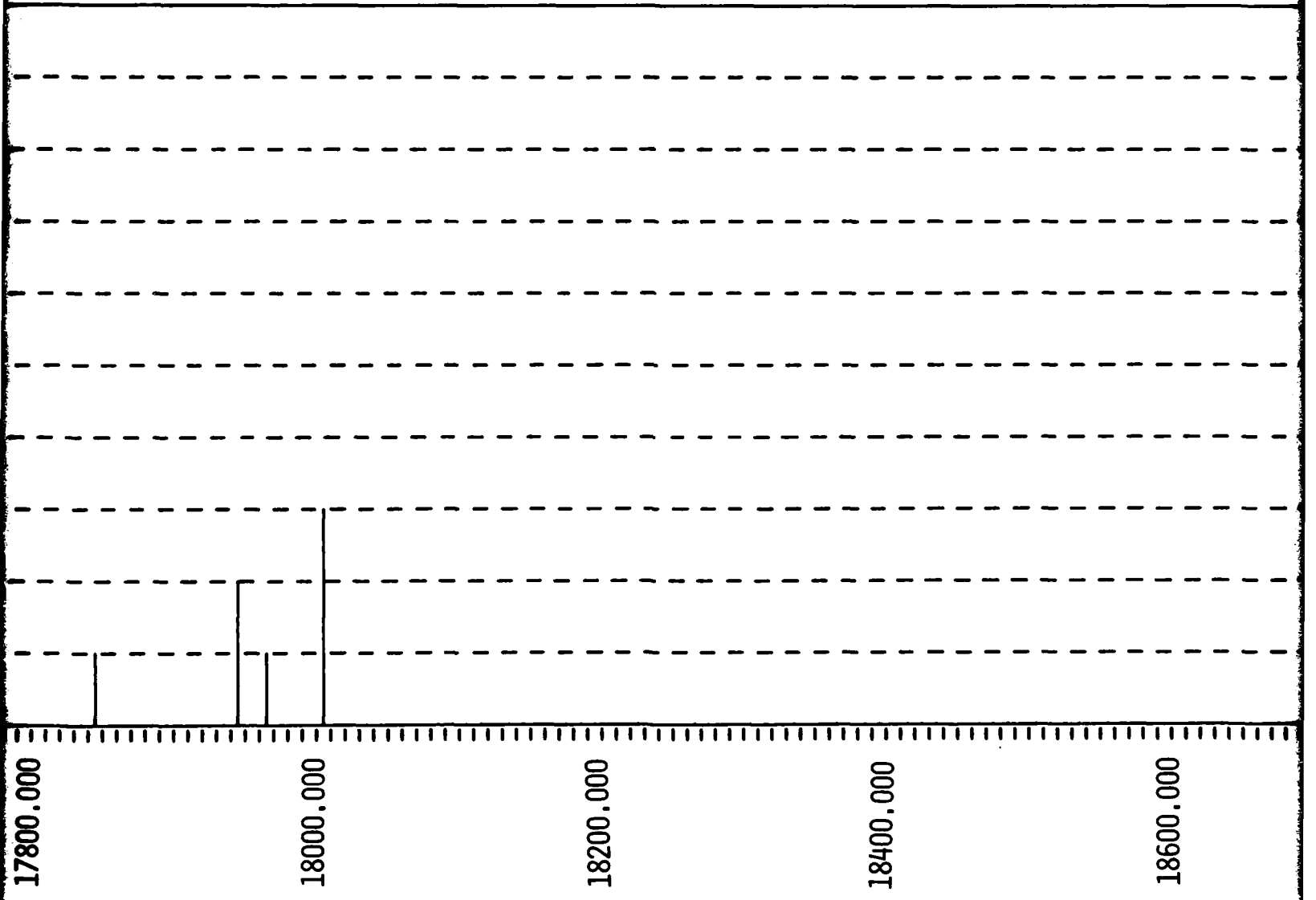
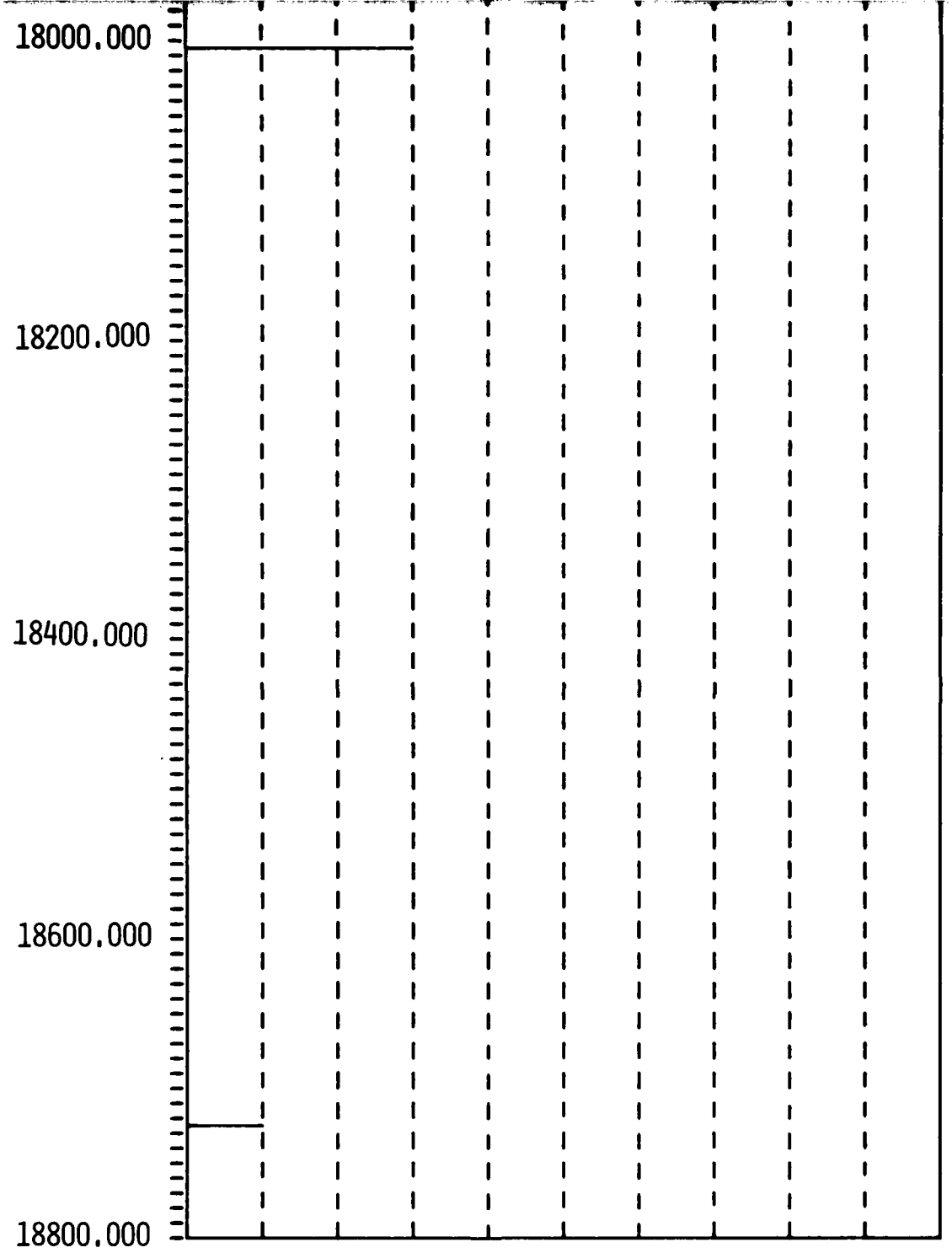
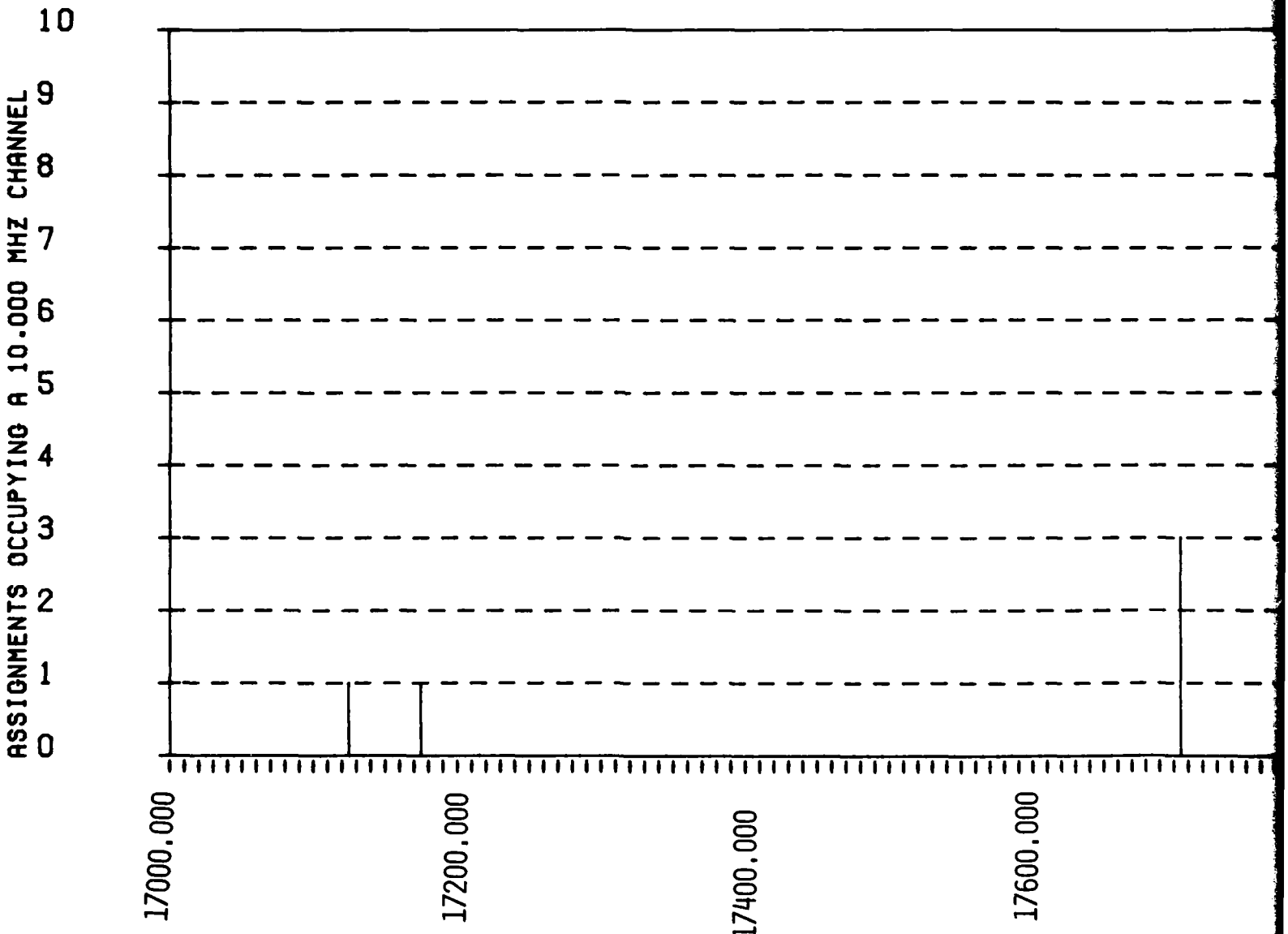


Figure 8.2


18000.000
18200.000
18400.000
18600.000
18800.000

REGION 3 (17.0


ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
17000.000
17200.000
17400.000
17600.000

18.8 GHz)

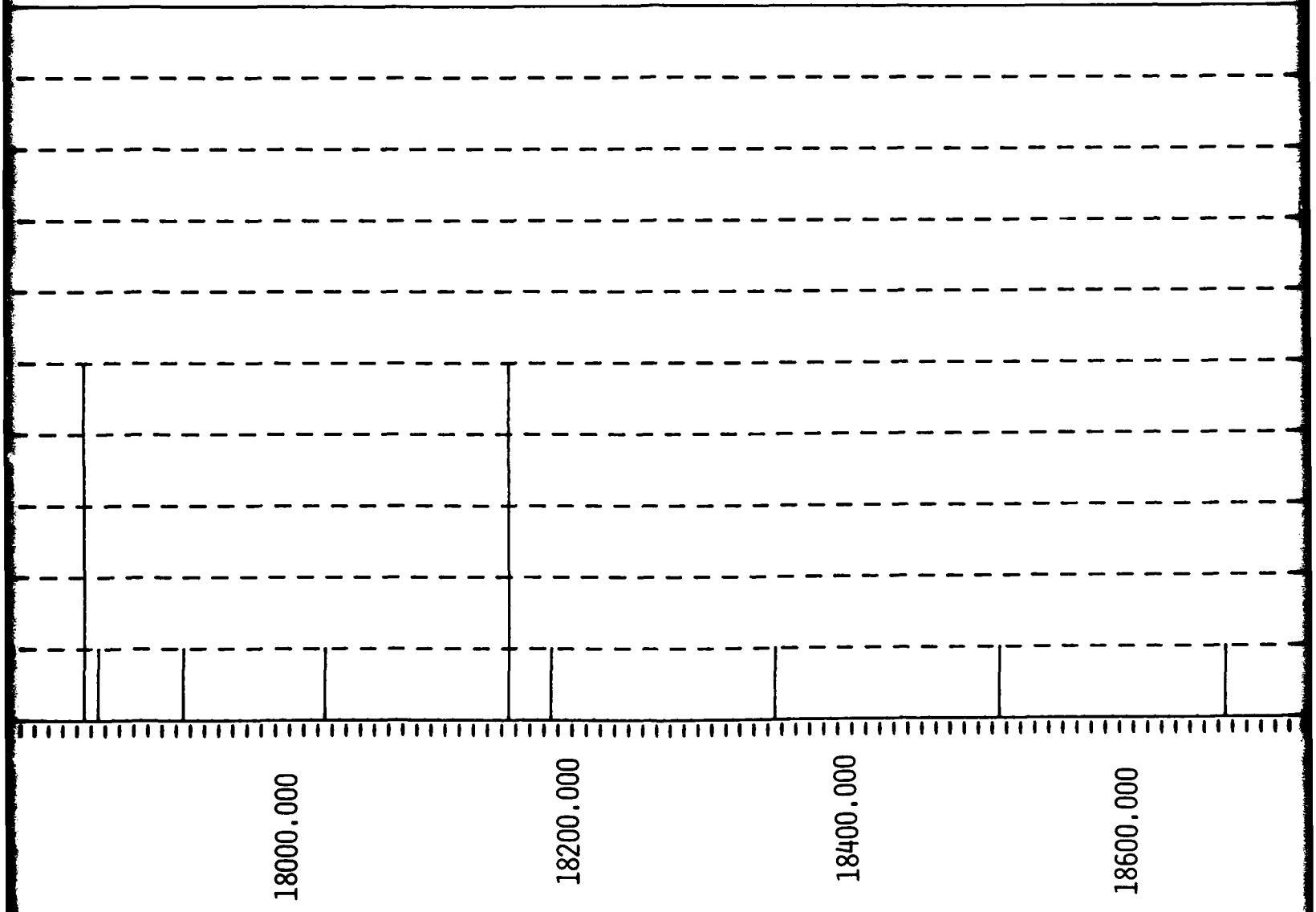
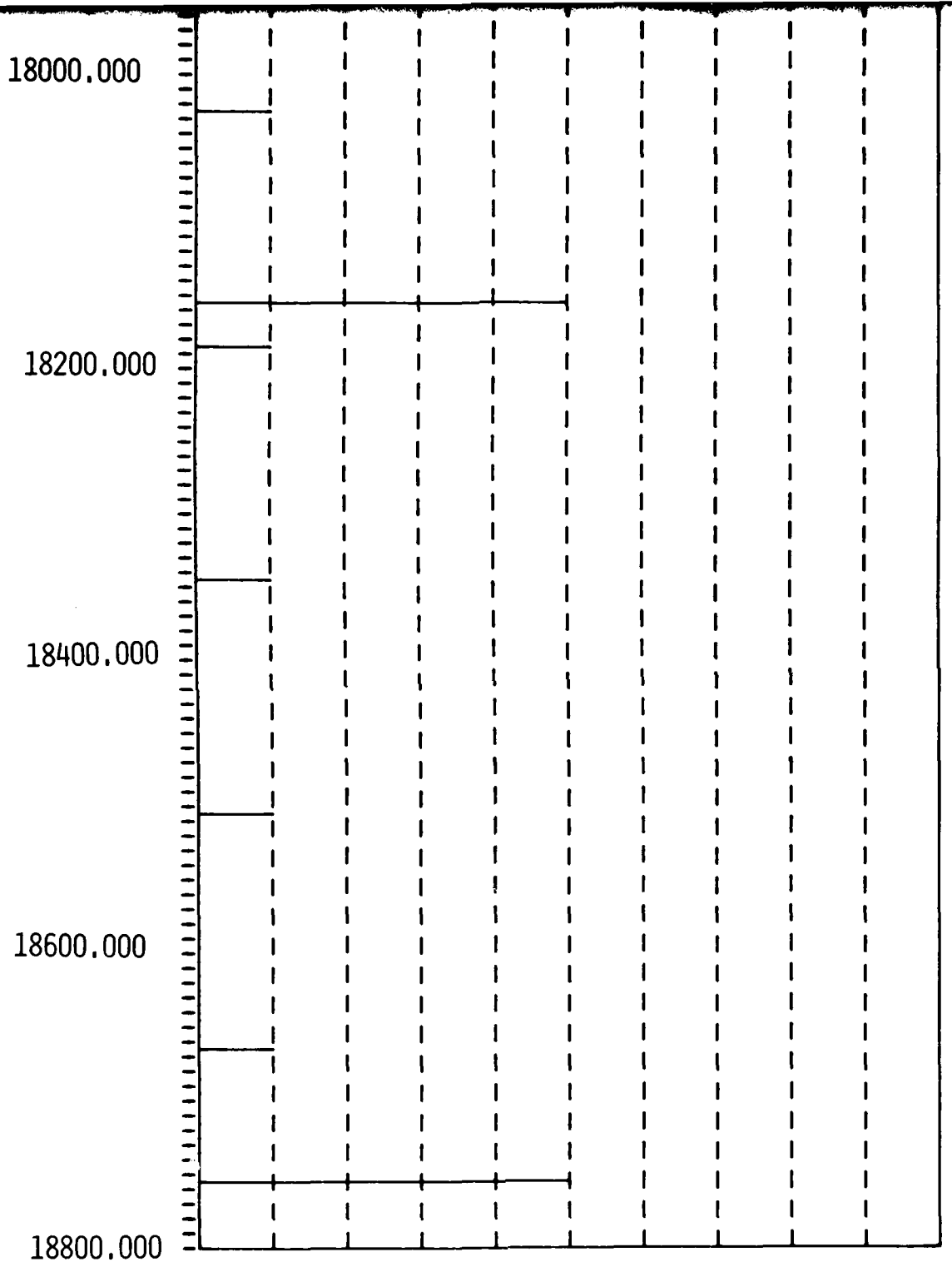
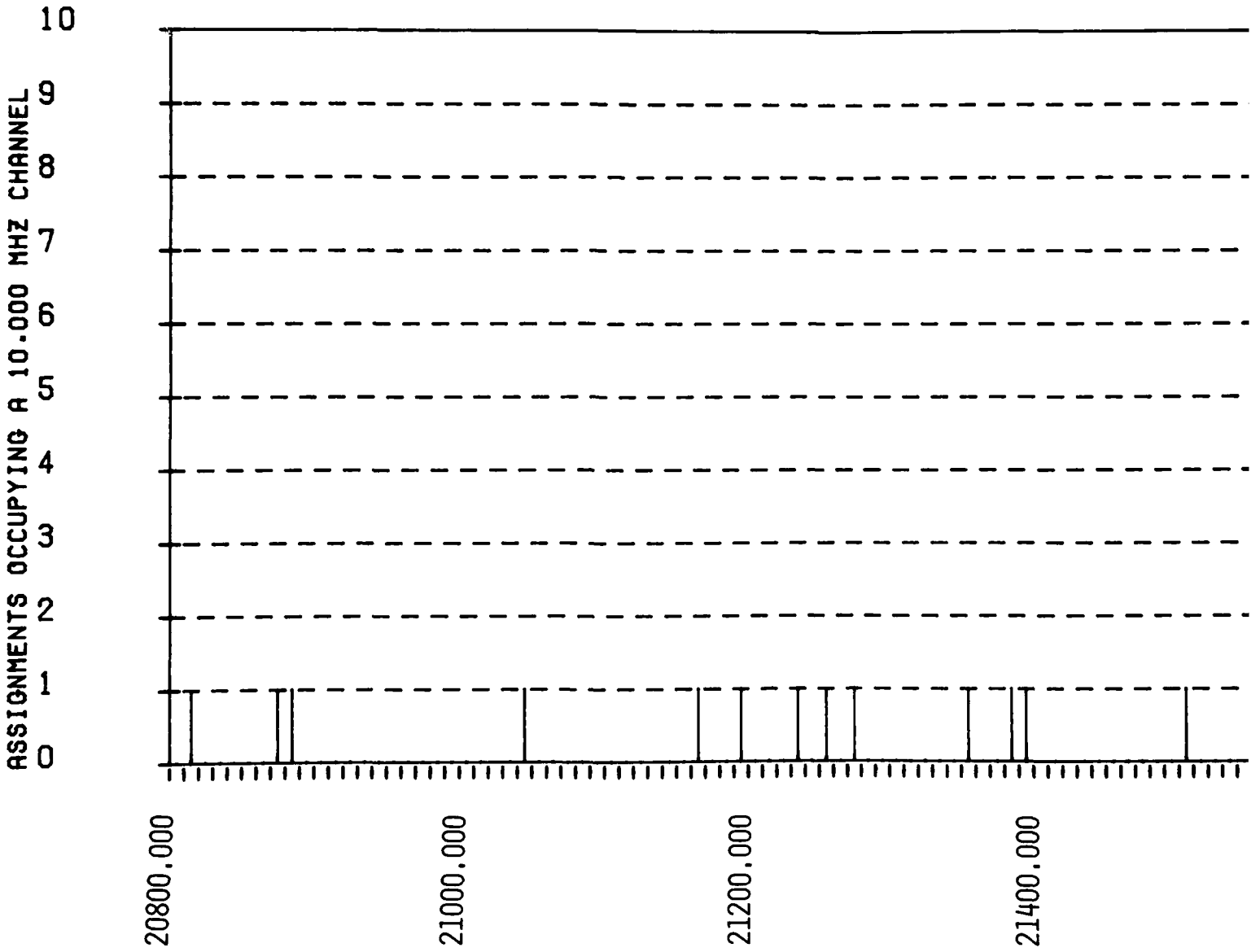


Figure 8.3


18000.000
18200.000
18400.000
18600.000
18800.000

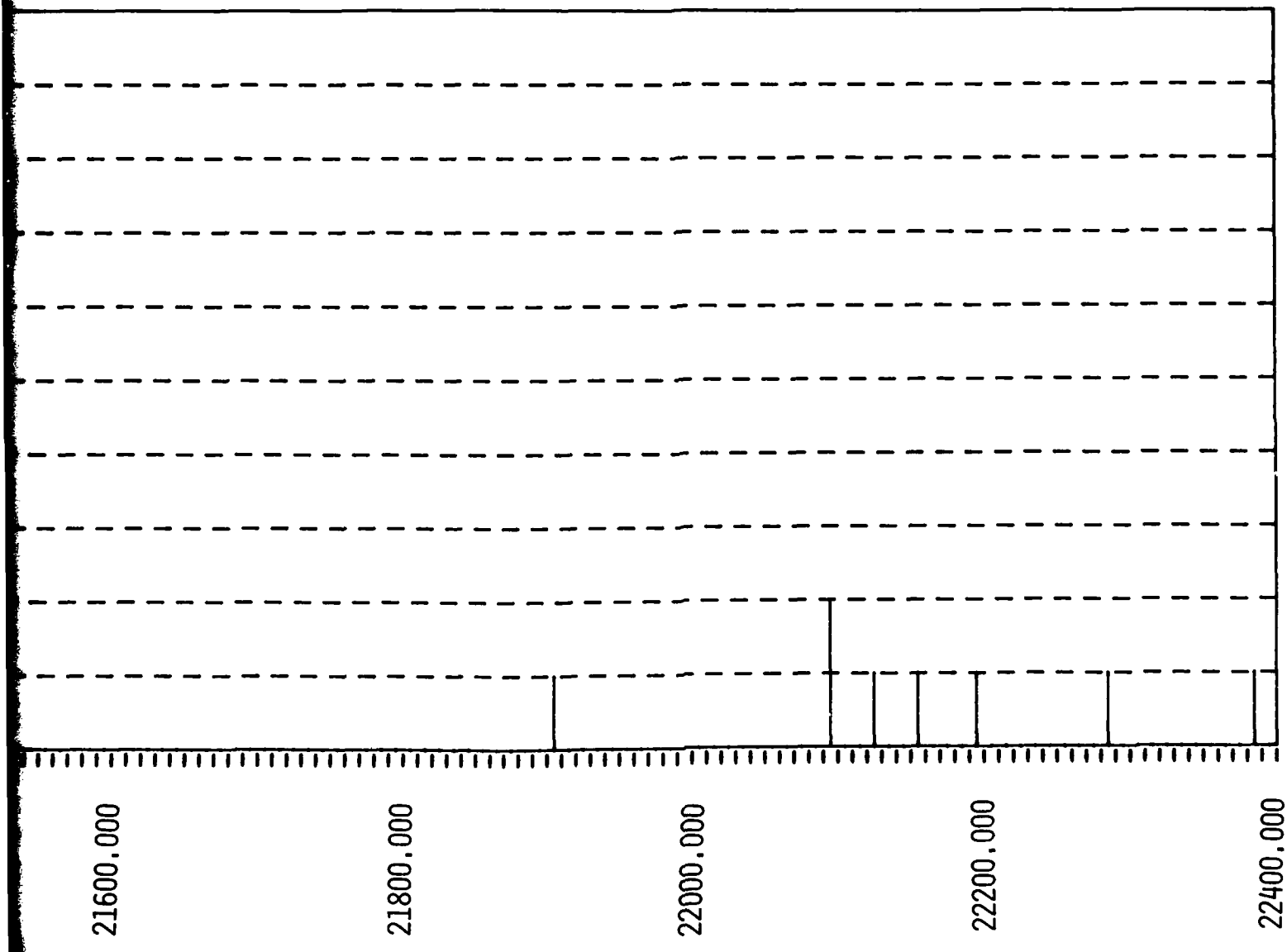
WORLD (20.8 TO 22.4 GH



21 EMITTERS PLOT

Figu

GHz)

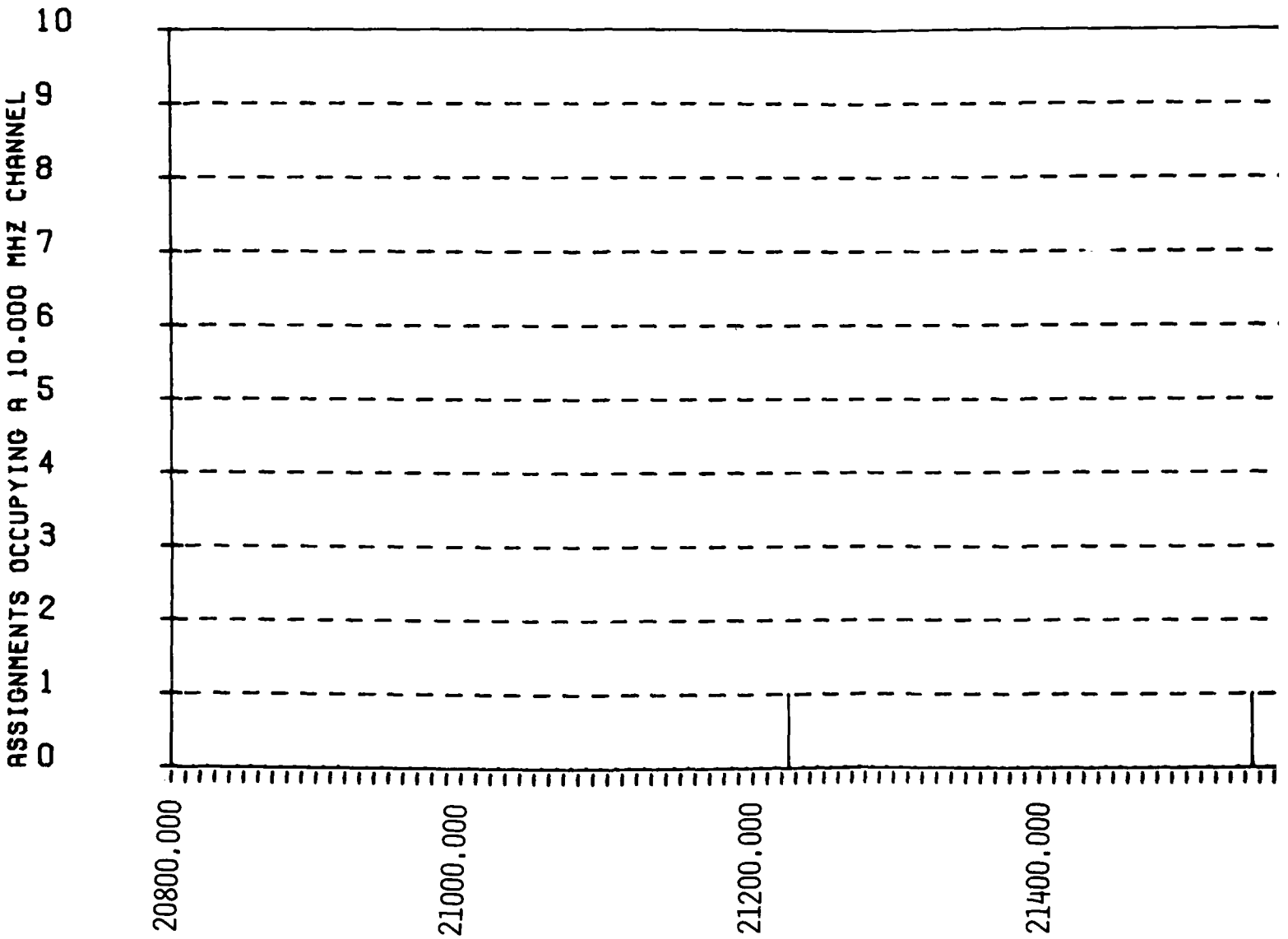


z)

TED

e 9

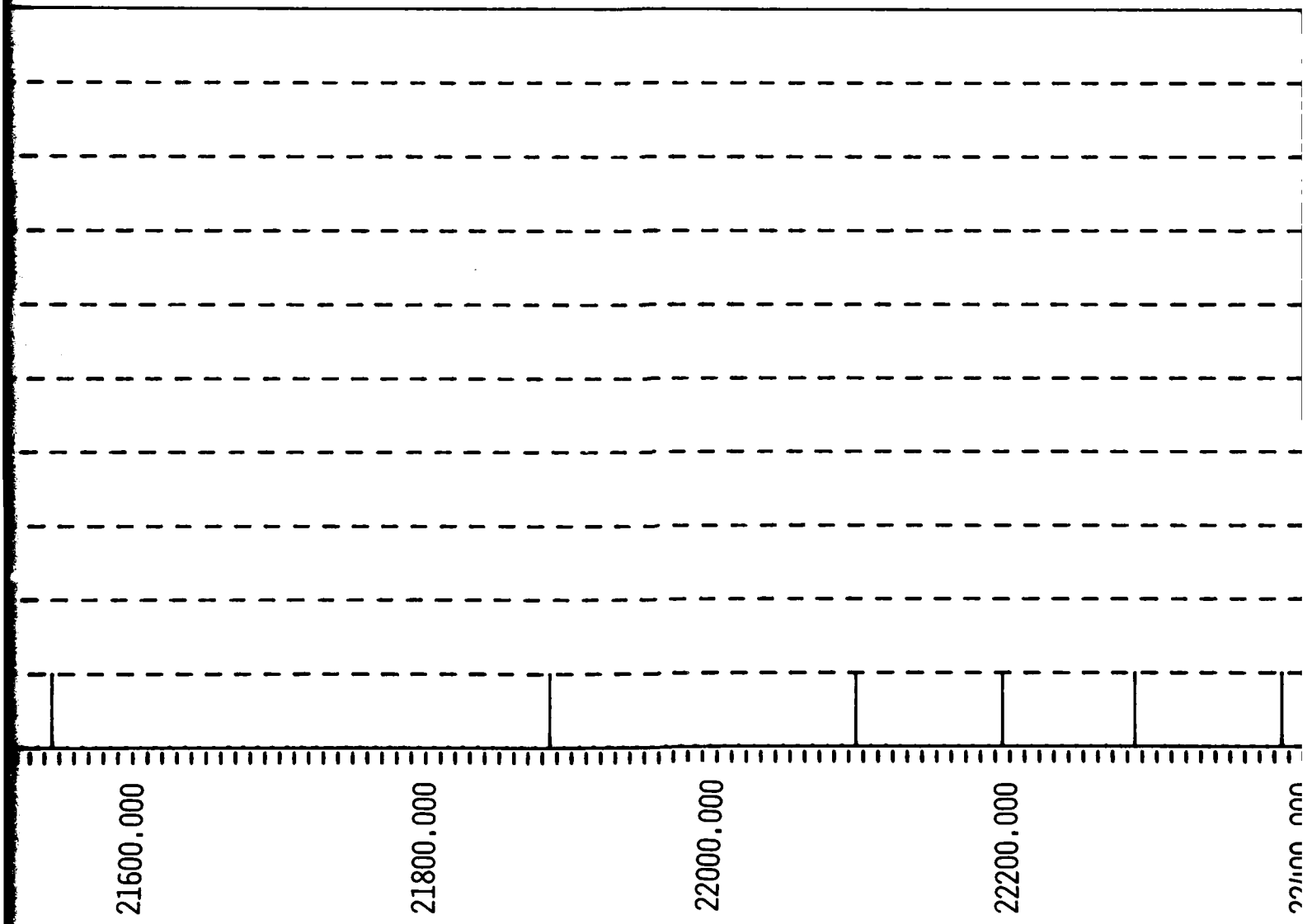
REGION 1 (20.8 TO 22.4



7 EMITTERS F

Figure

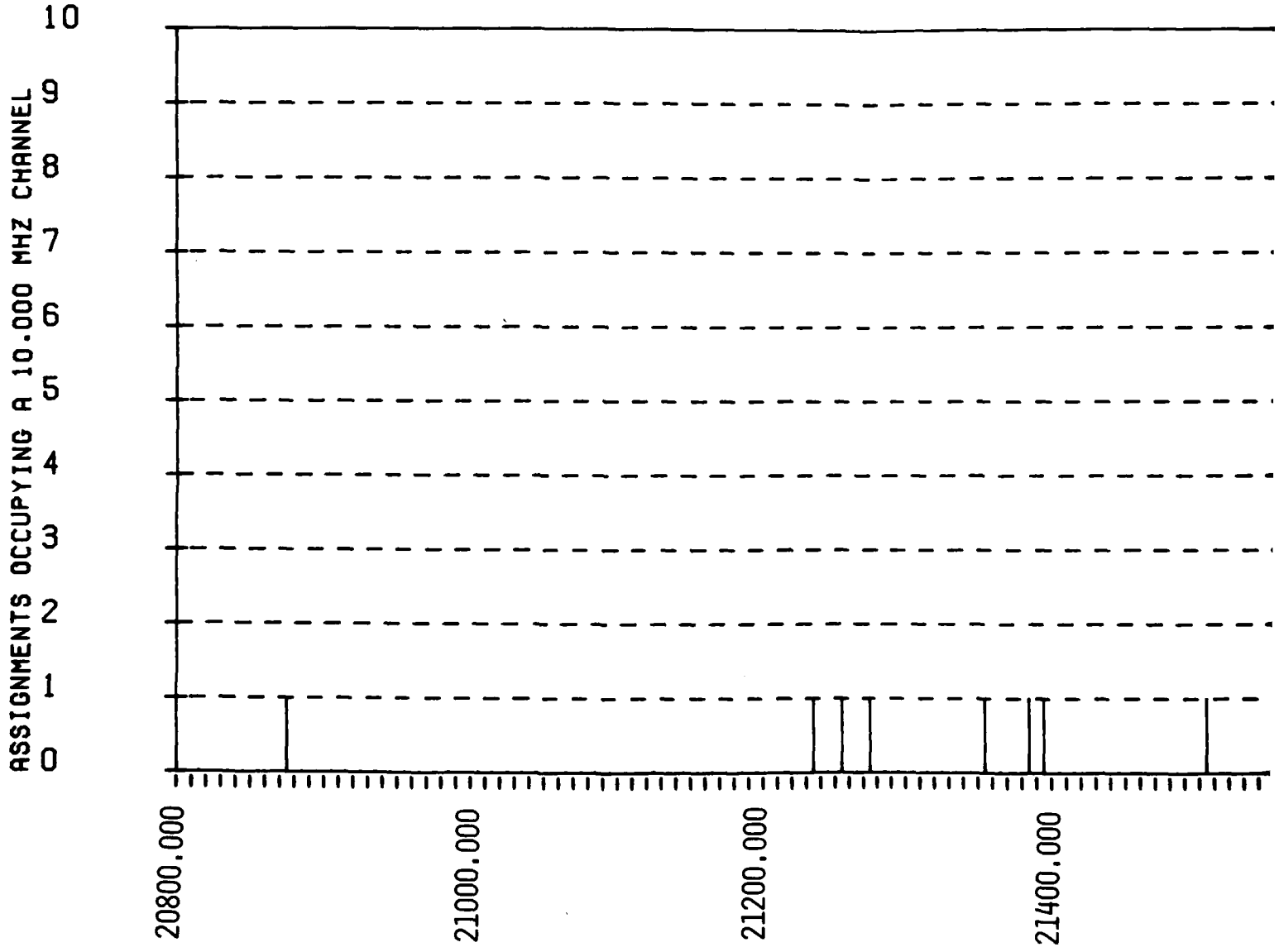
22.4 GHz)



NCY (MHz)
RS PLOTTED

gure 9.1

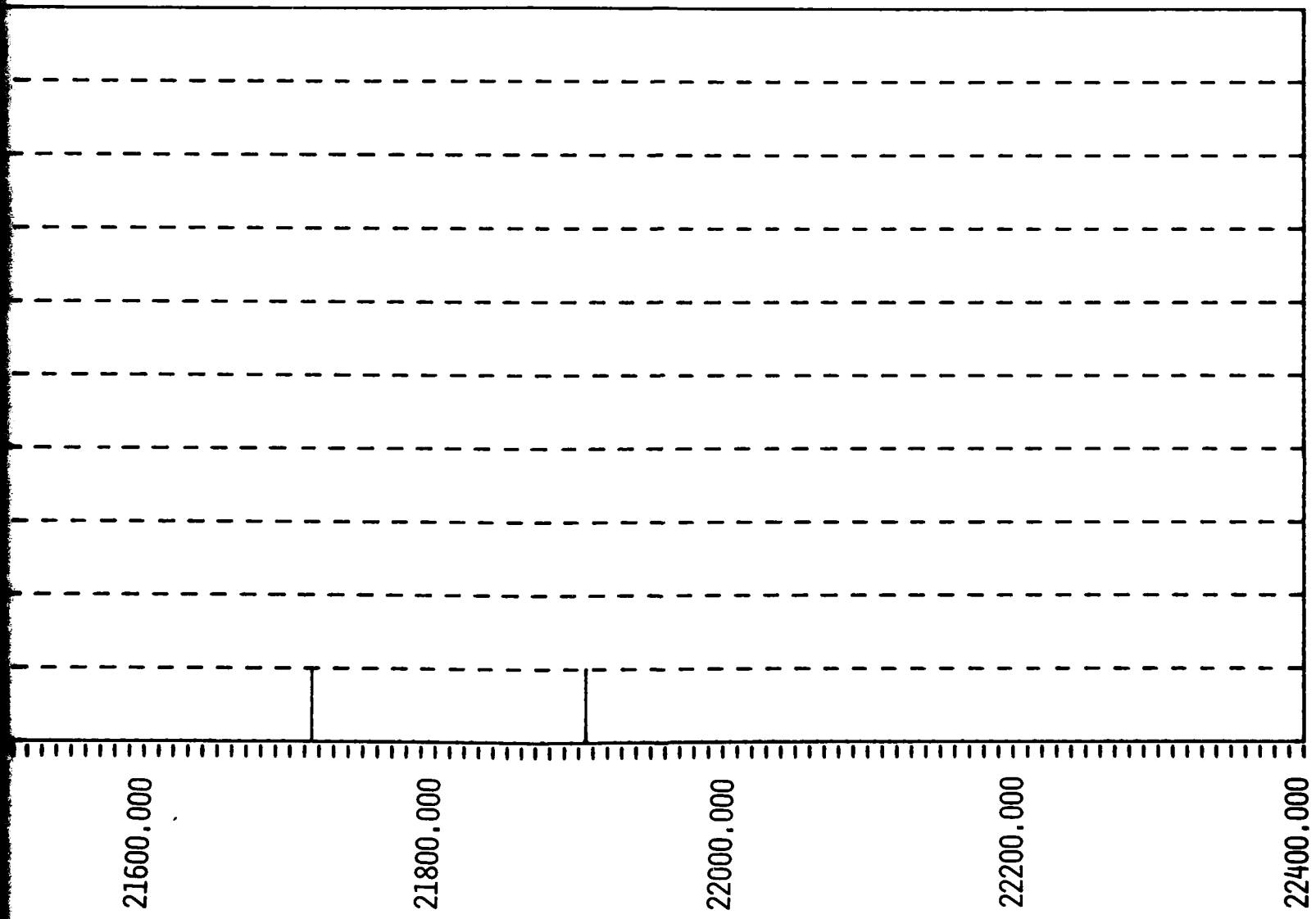
REGION 2 (20.8 TO 22.4



10 EMITTERS

Figu

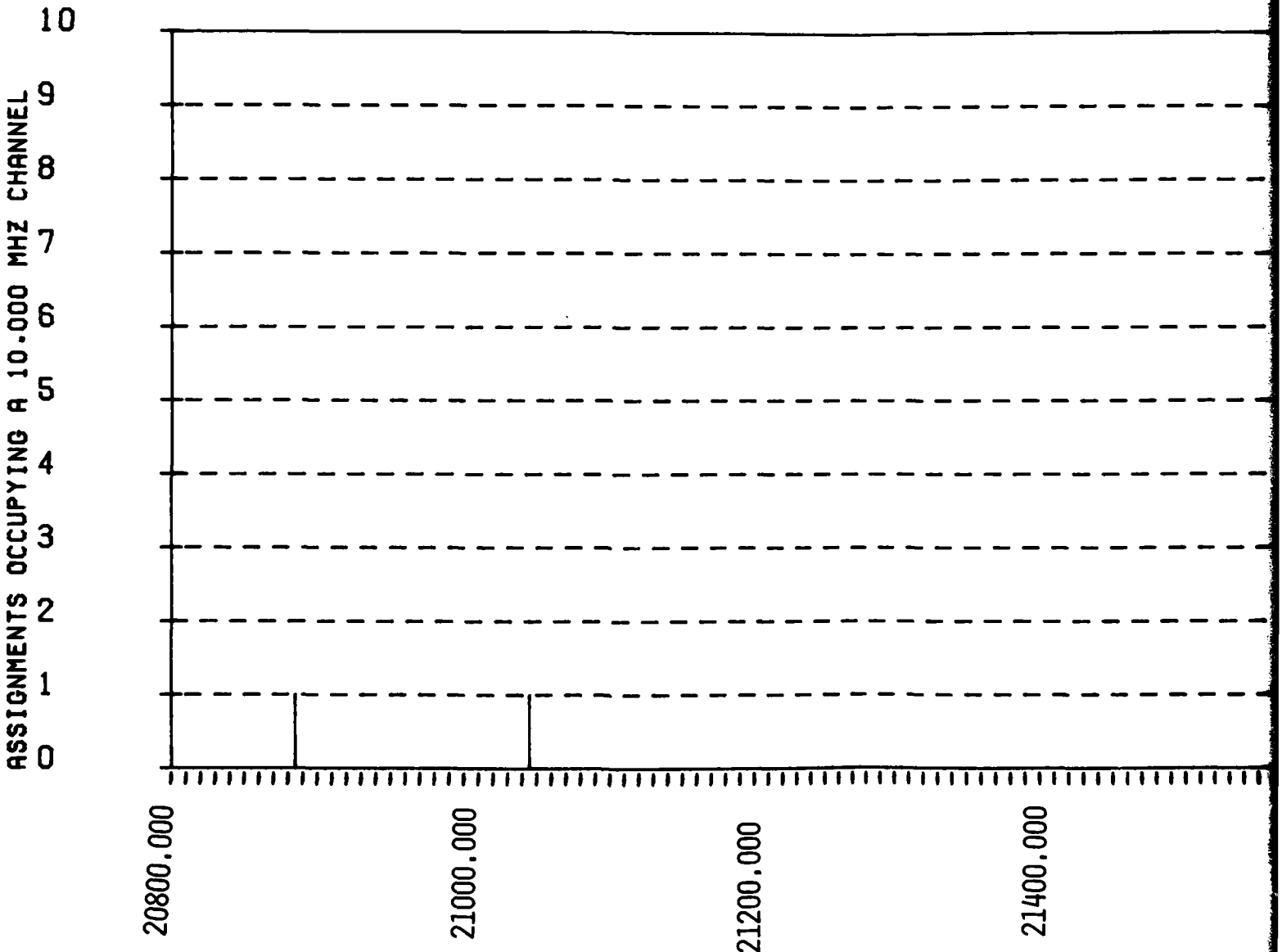
22.4 GHz)



NCY (MHz)
ERS PLOTTED

Figure 9.2

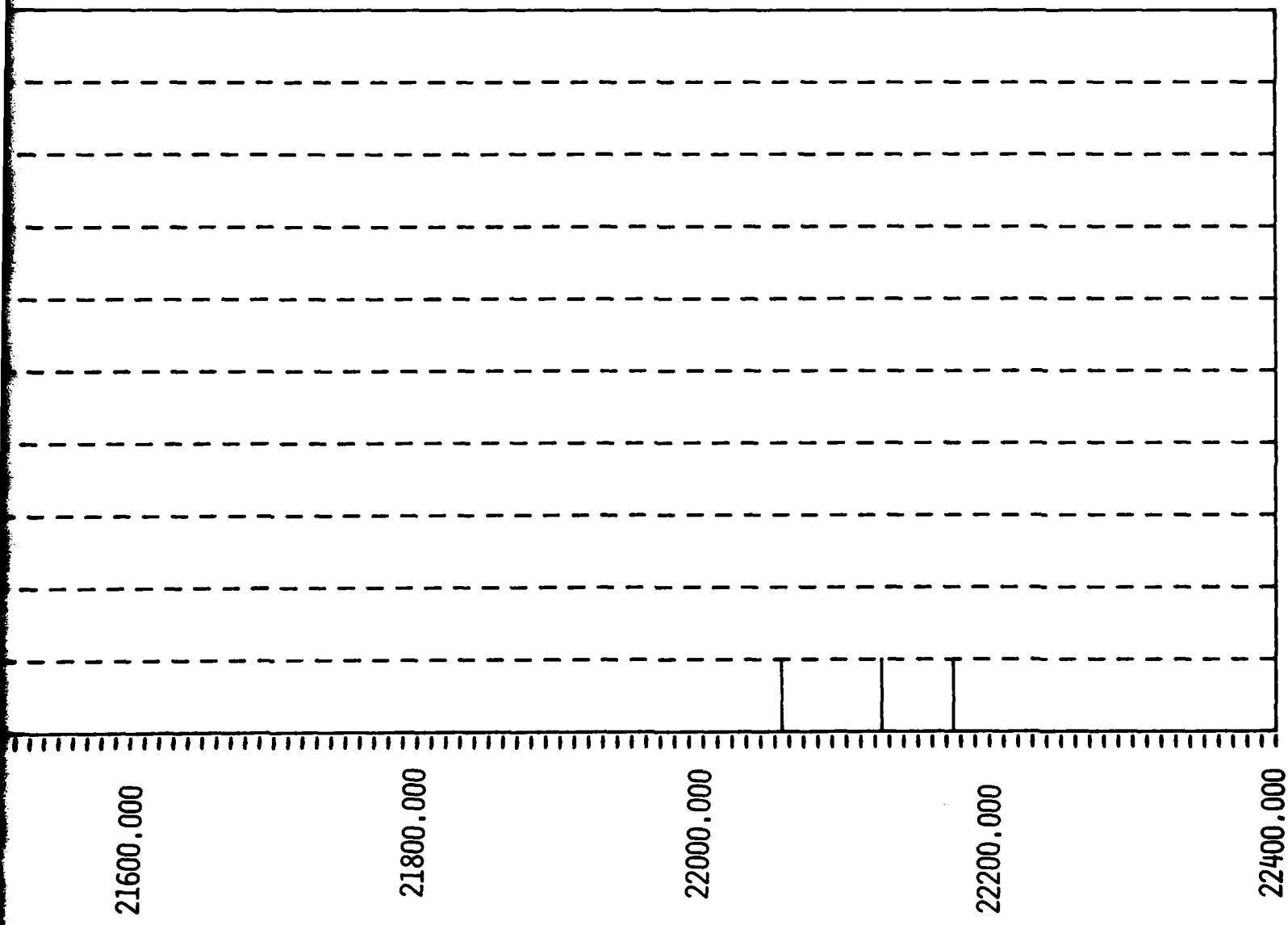
REGION 3 (20.8 TO 22.4 G



5 EMITTERS PLOTT

Figur

.4 GHz)



(MHz)

LOTTED

Figure 9.3

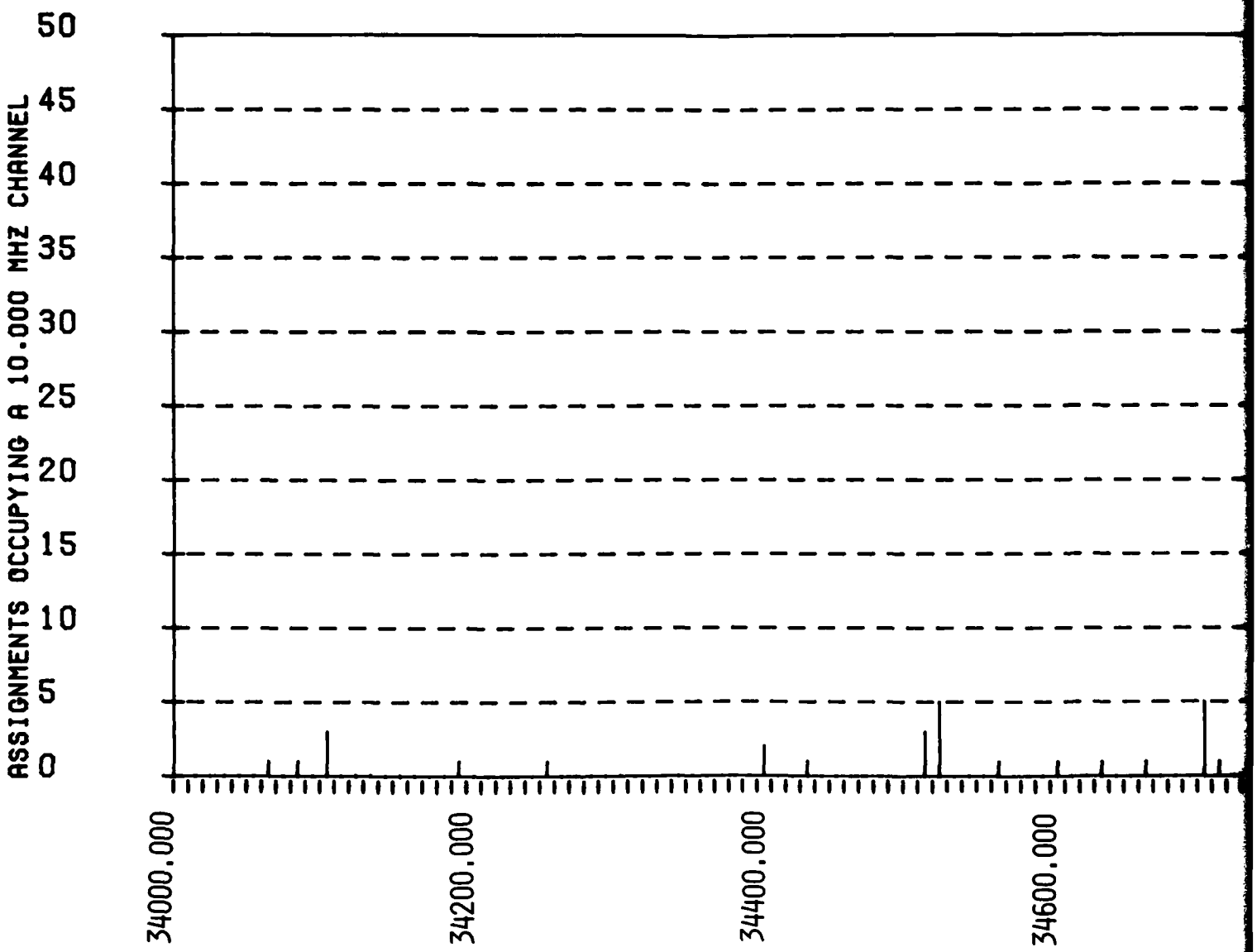
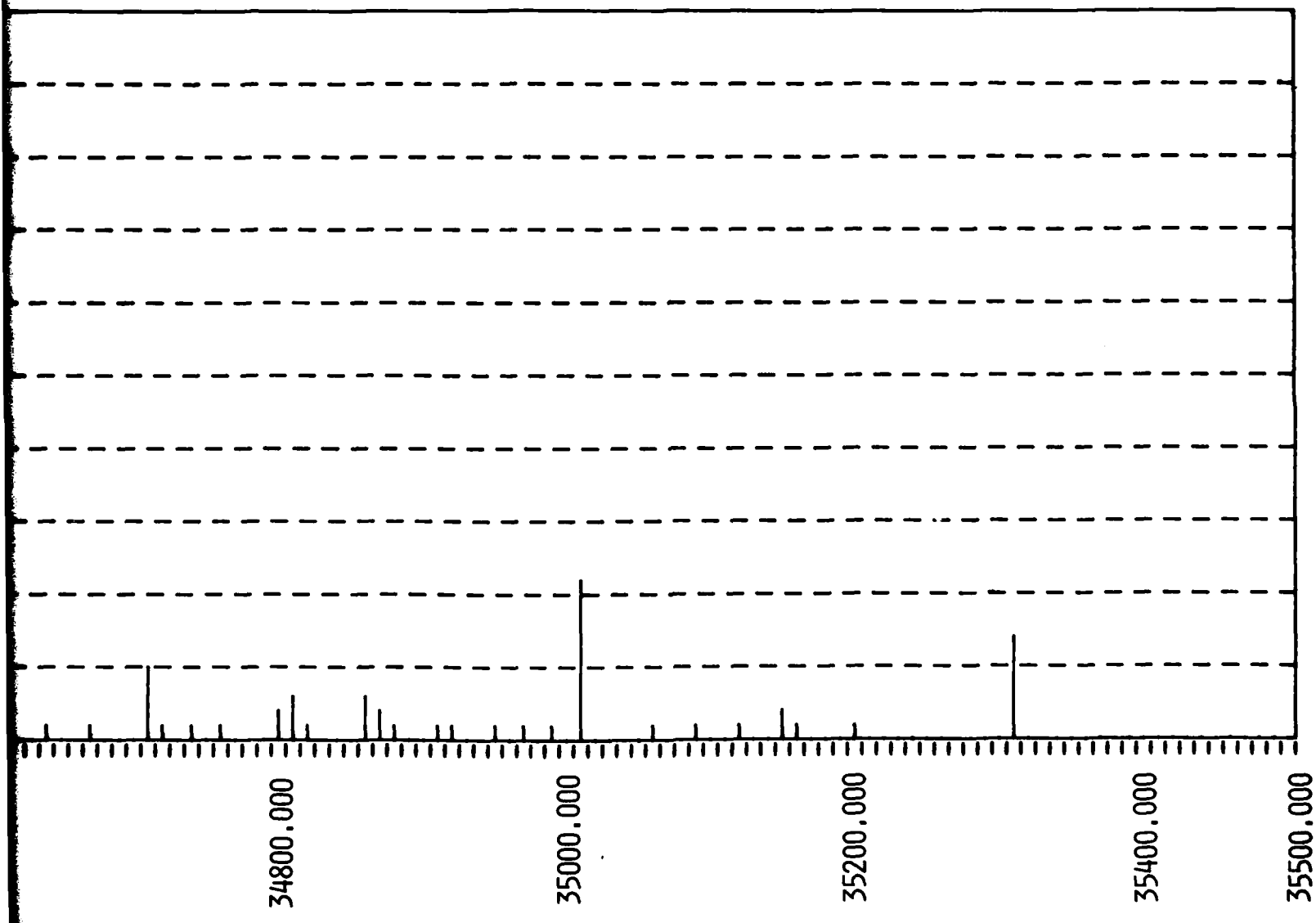

WORLD (34.0 TO
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
34000.000
34200.000
34400.000
34600.000
FREQUENCY (
72 EMITTERS PL

Figure 10

LD (34.0 TO 35.5 GHz)



FREQUENCY (MHz)

EMITTERS PLOTTED

Figure 10

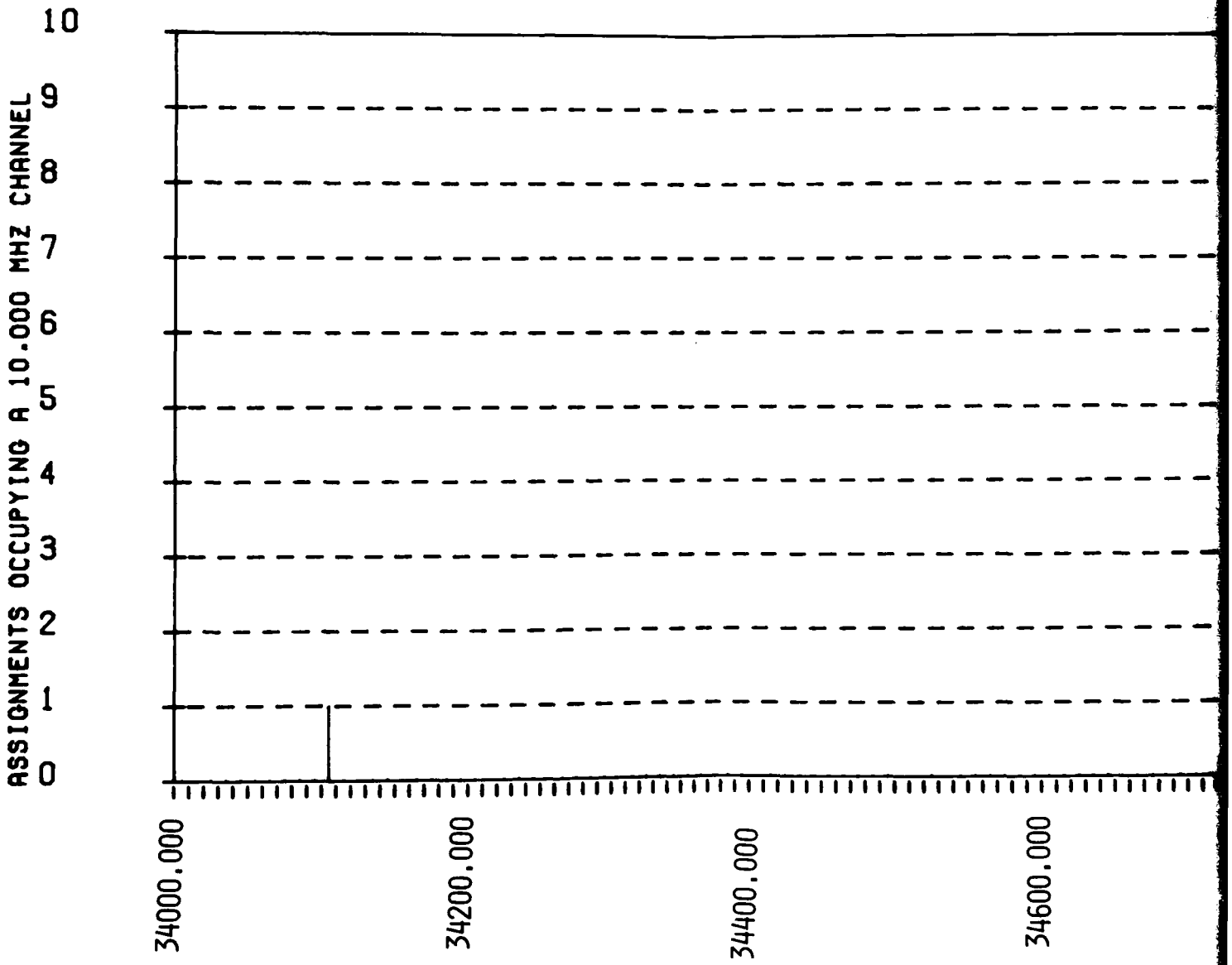
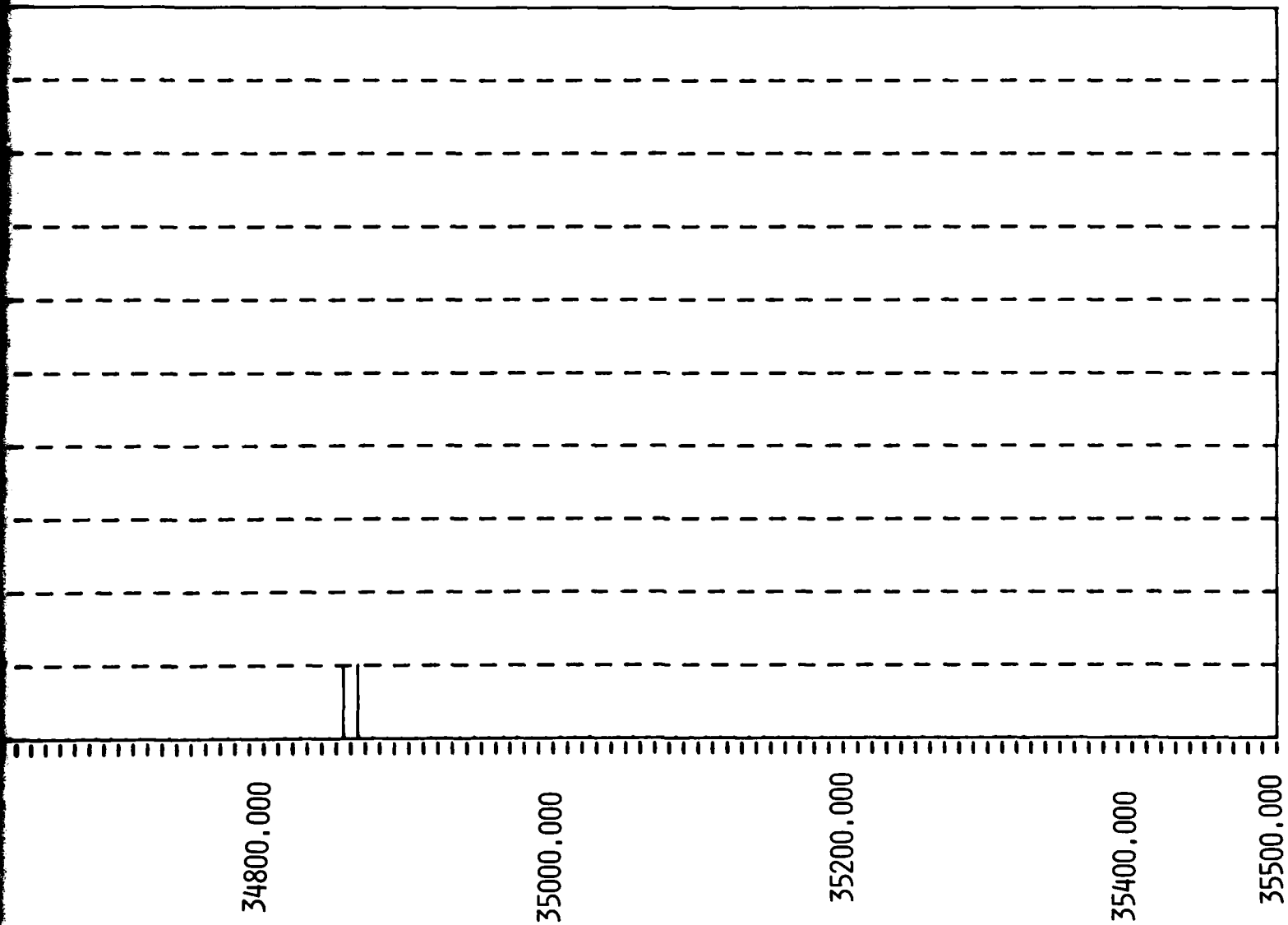

REGION 1 (34.0 TO 35.5 GH
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
34000.000
34200.000
34400.000
34600.000
FREQUENCY (MHz
3 EMITTERS PLOT

Figure 10.

o 35.5 GHz)

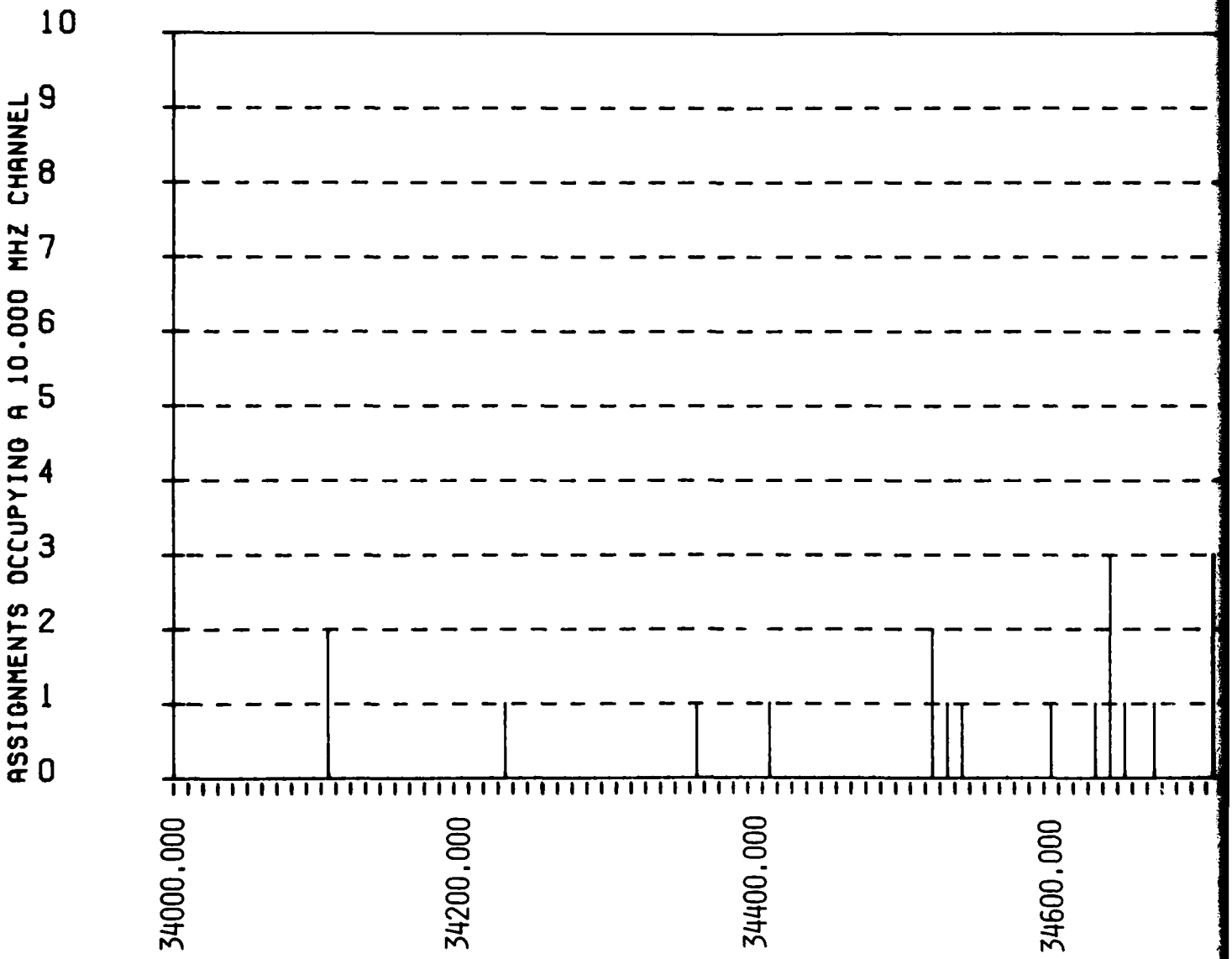


UENCY (MHz)

TTERS PLOTTED

Figure 10.1

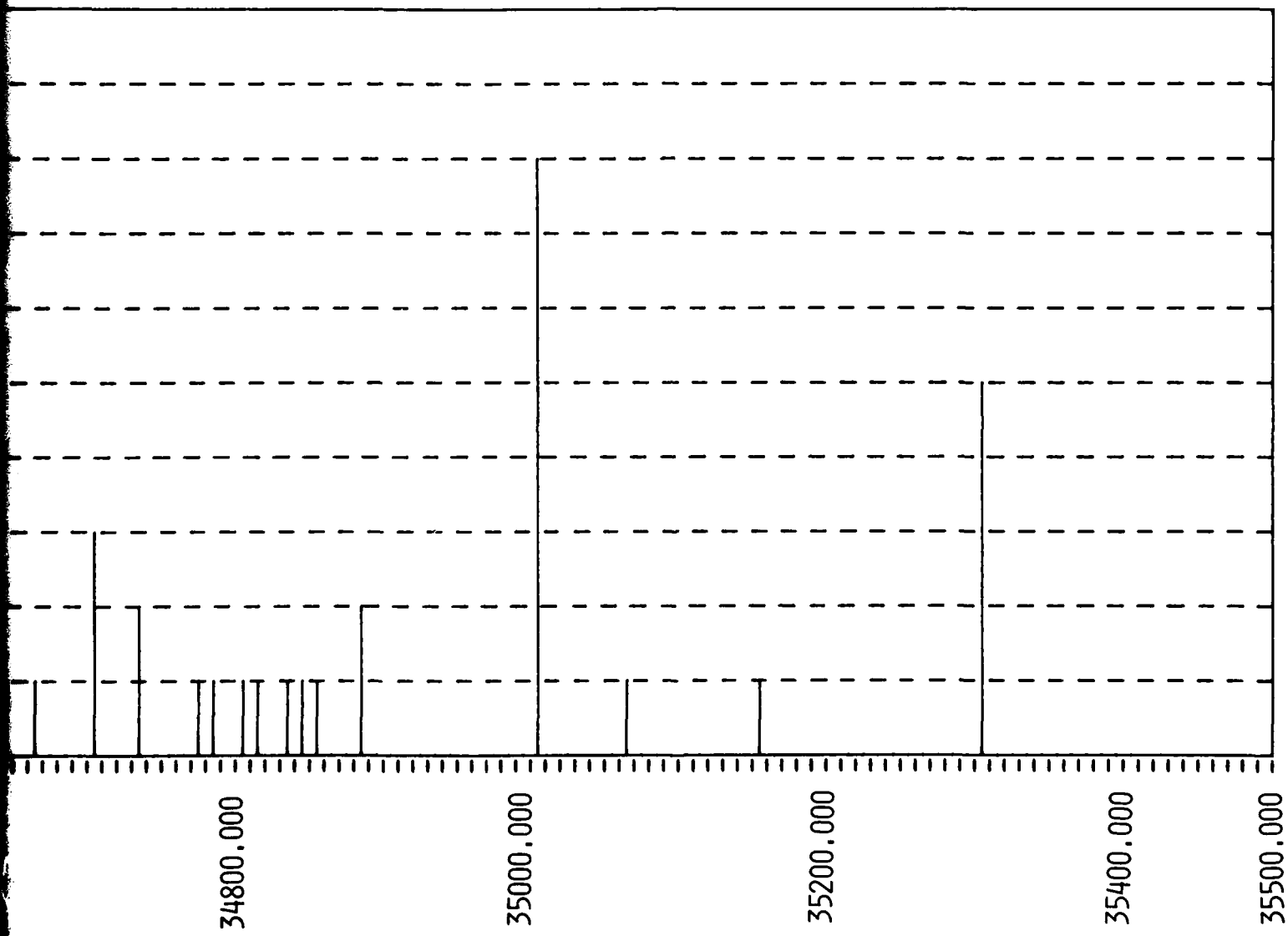
REGION 2 (34.0 TO 35.5 GH



45 EMITTERS PLOTT

Figur

5.5 GHz)

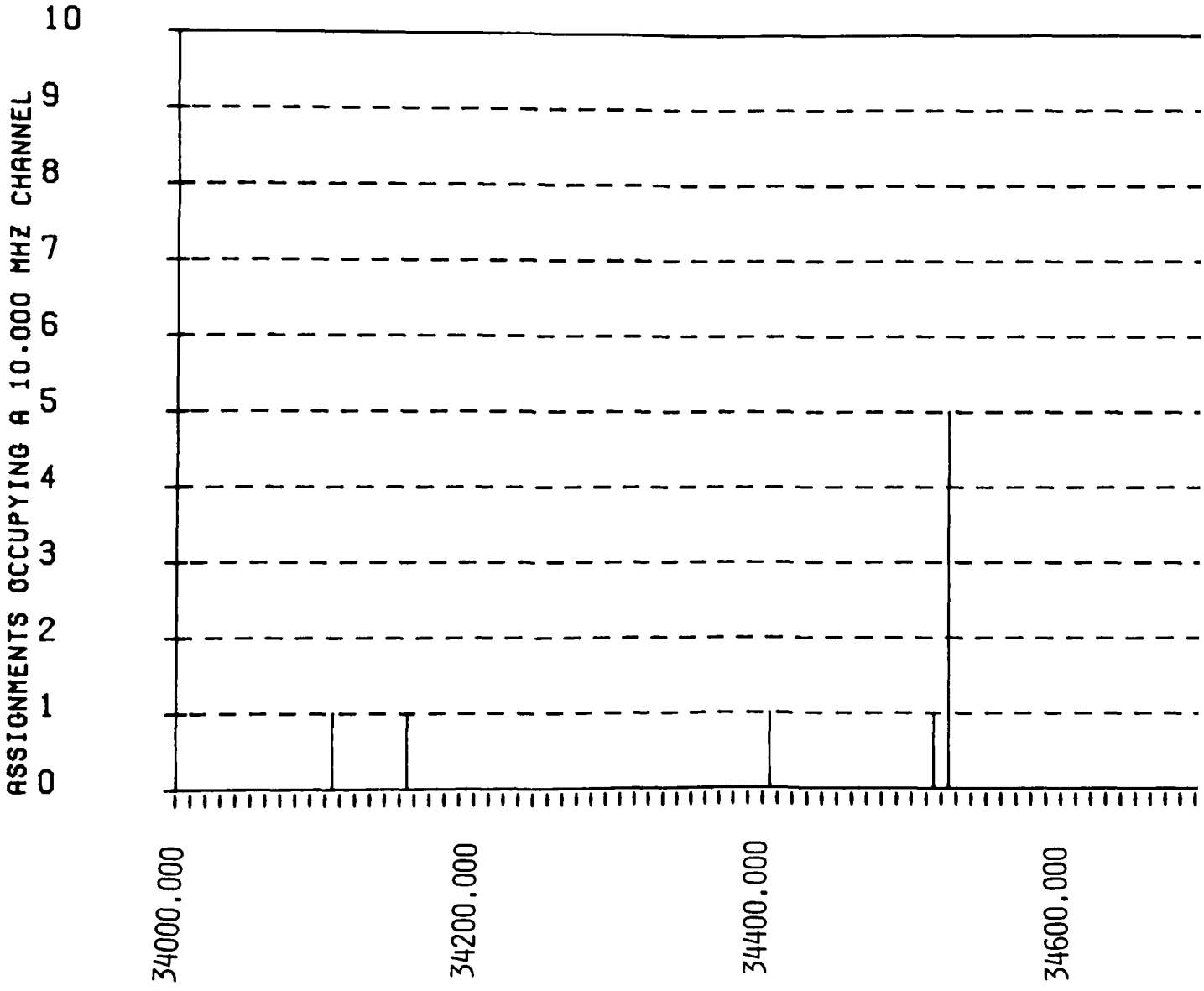


(MHz)

PLOTTED

Figure 10.2

REGION 3 (34.0 TO 35.5 (

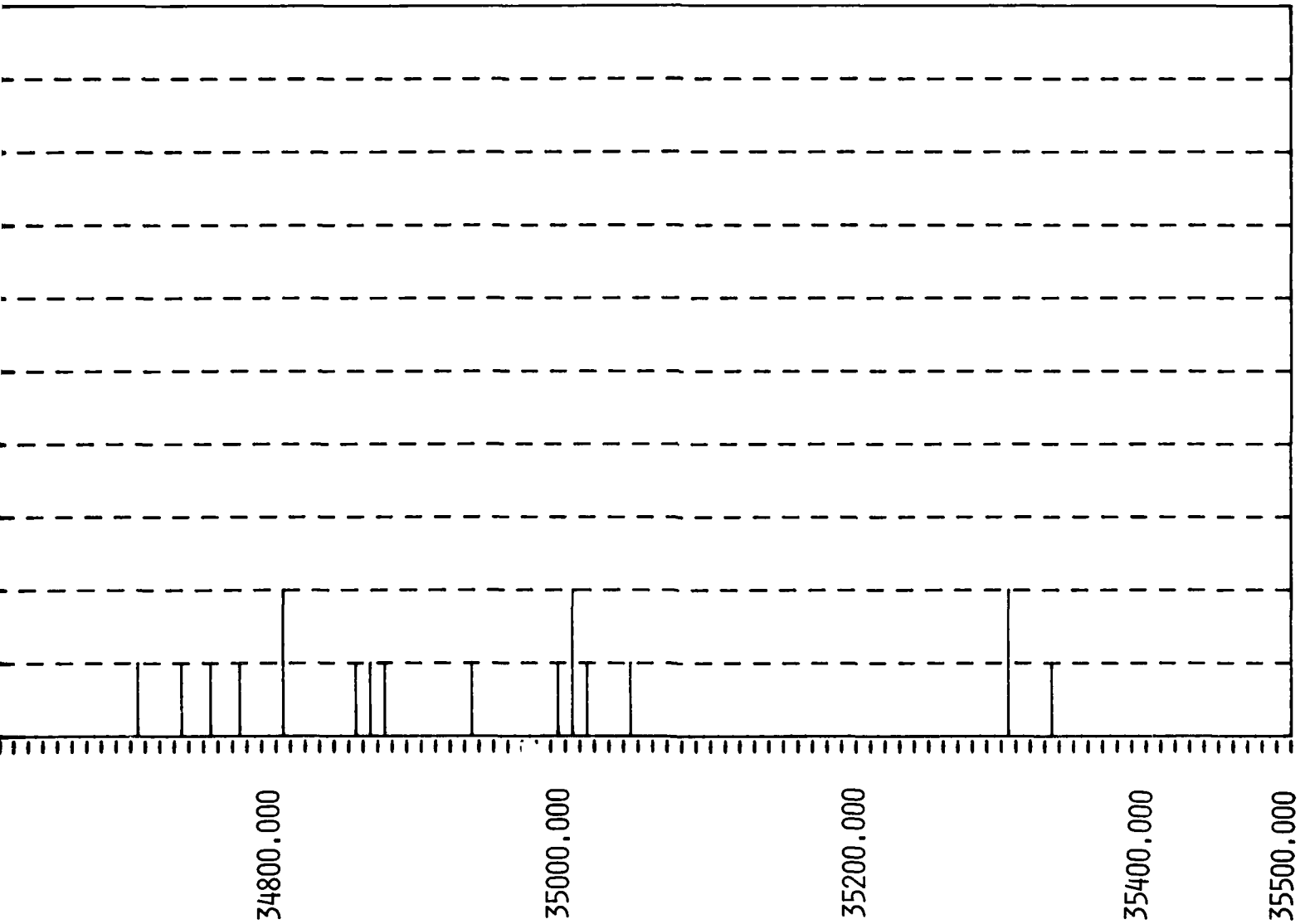


FREQUENCY (MHz

27 EMITTERS PLOTT

Fig

ro 35.5 GHz)



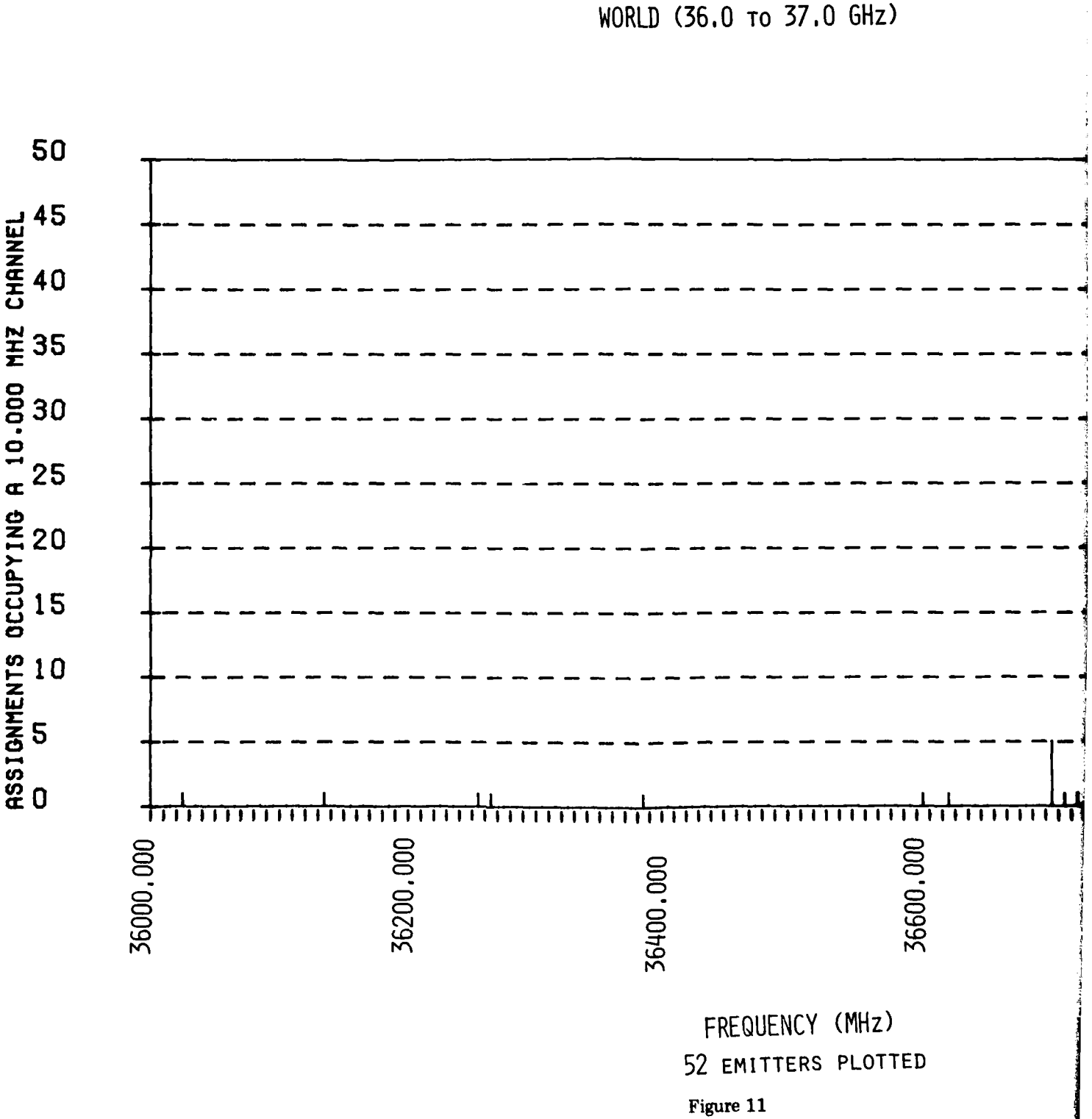

WORLD (36.0 TO 37.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
36000.000
36200.000
36400.000
36600.000
FREQUENCY (MHz)
52 EMITTERS PLOTTED

Figure 11

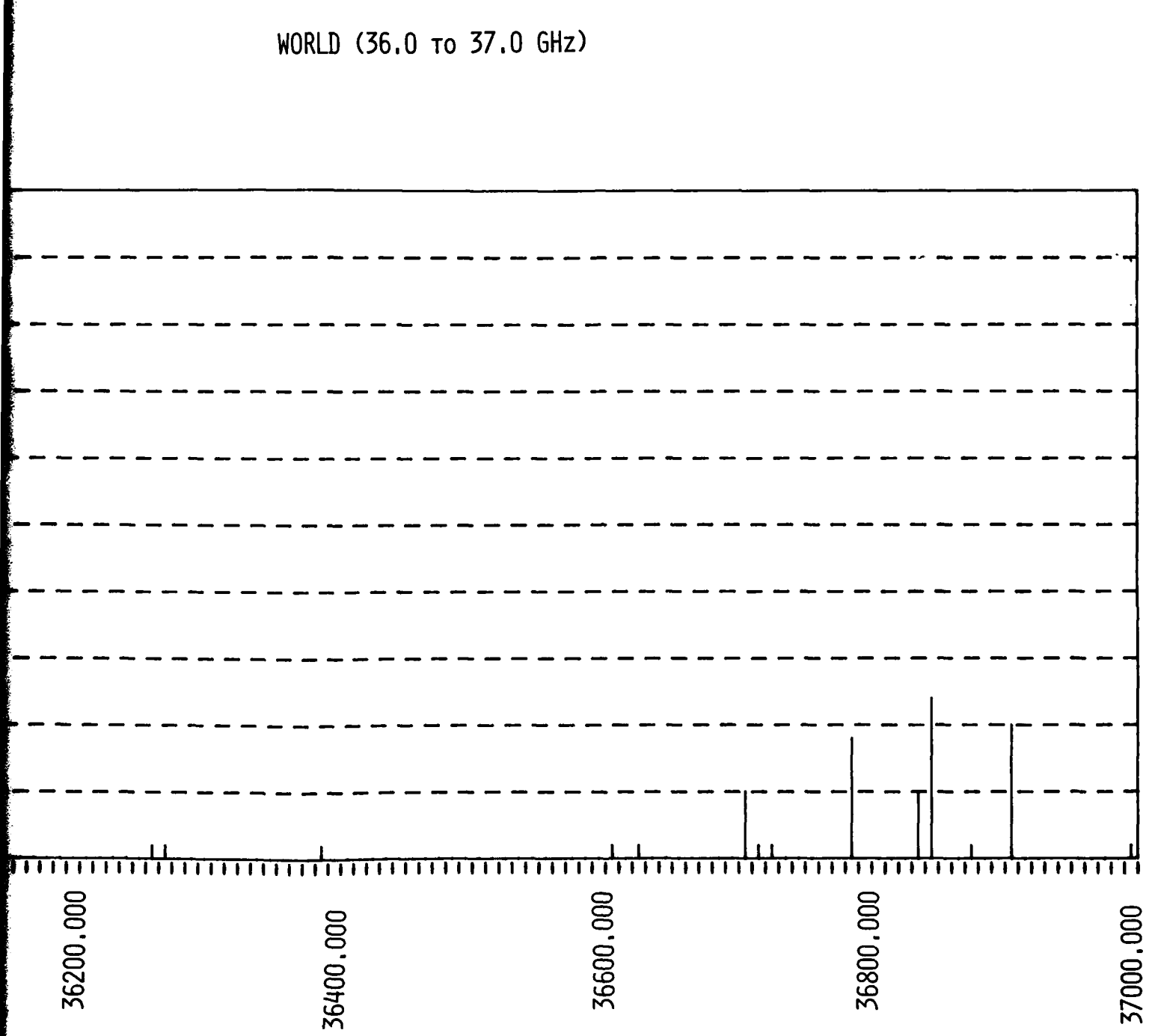

WORLD (36.0 TO 37.0 GHz)
36200.000
36400.000
36600.000
36800.000
37000.000
FREQUENCY (MHz)
52 EMITTERS PLOTTED

Figure 11

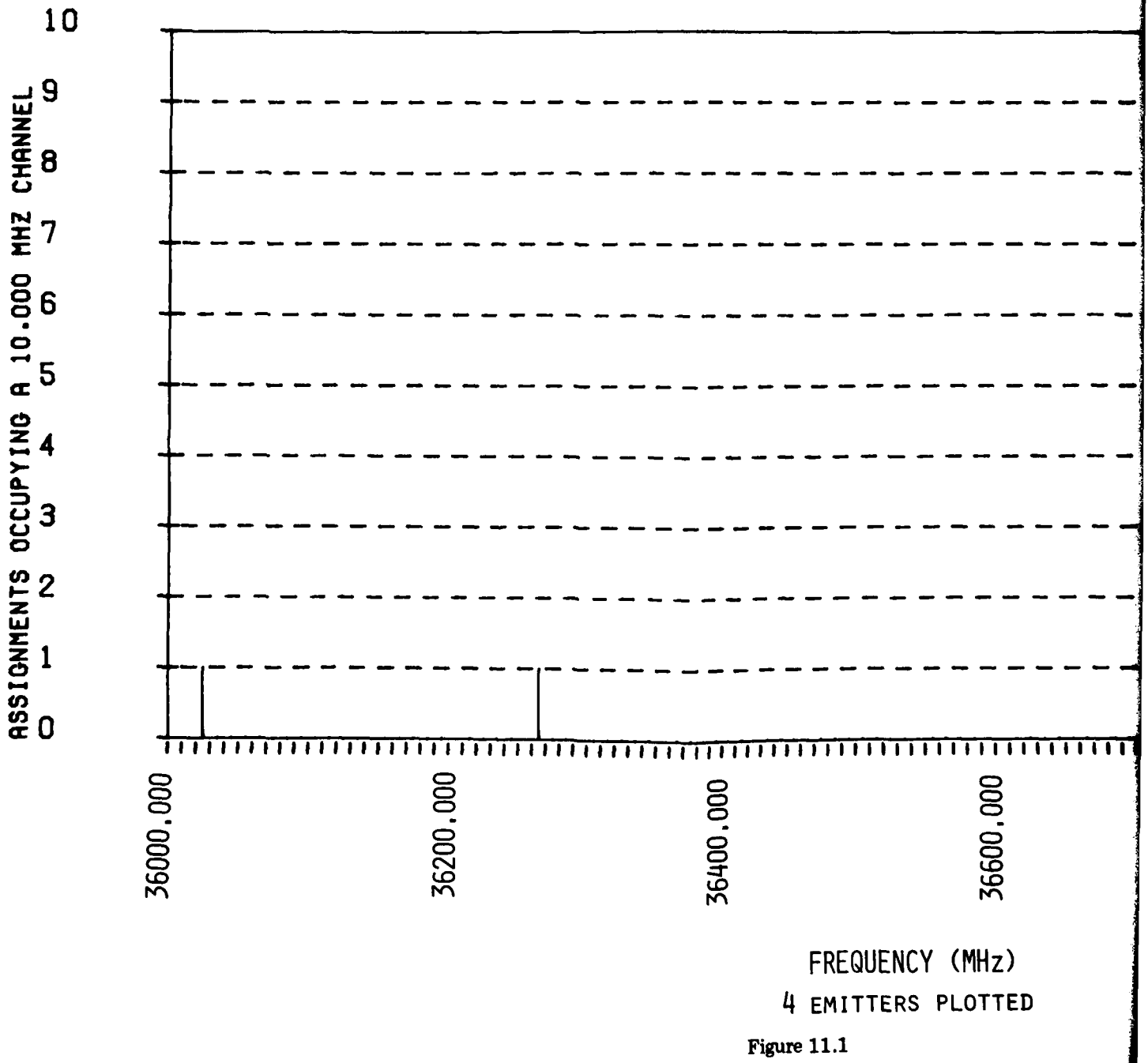

REGION 1 (36.0 TO 37.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
36000.000
36200.000
36400.000
36600.000
FREQUENCY (MHz)
4 EMITTERS PLOTTED

Figure 11.1

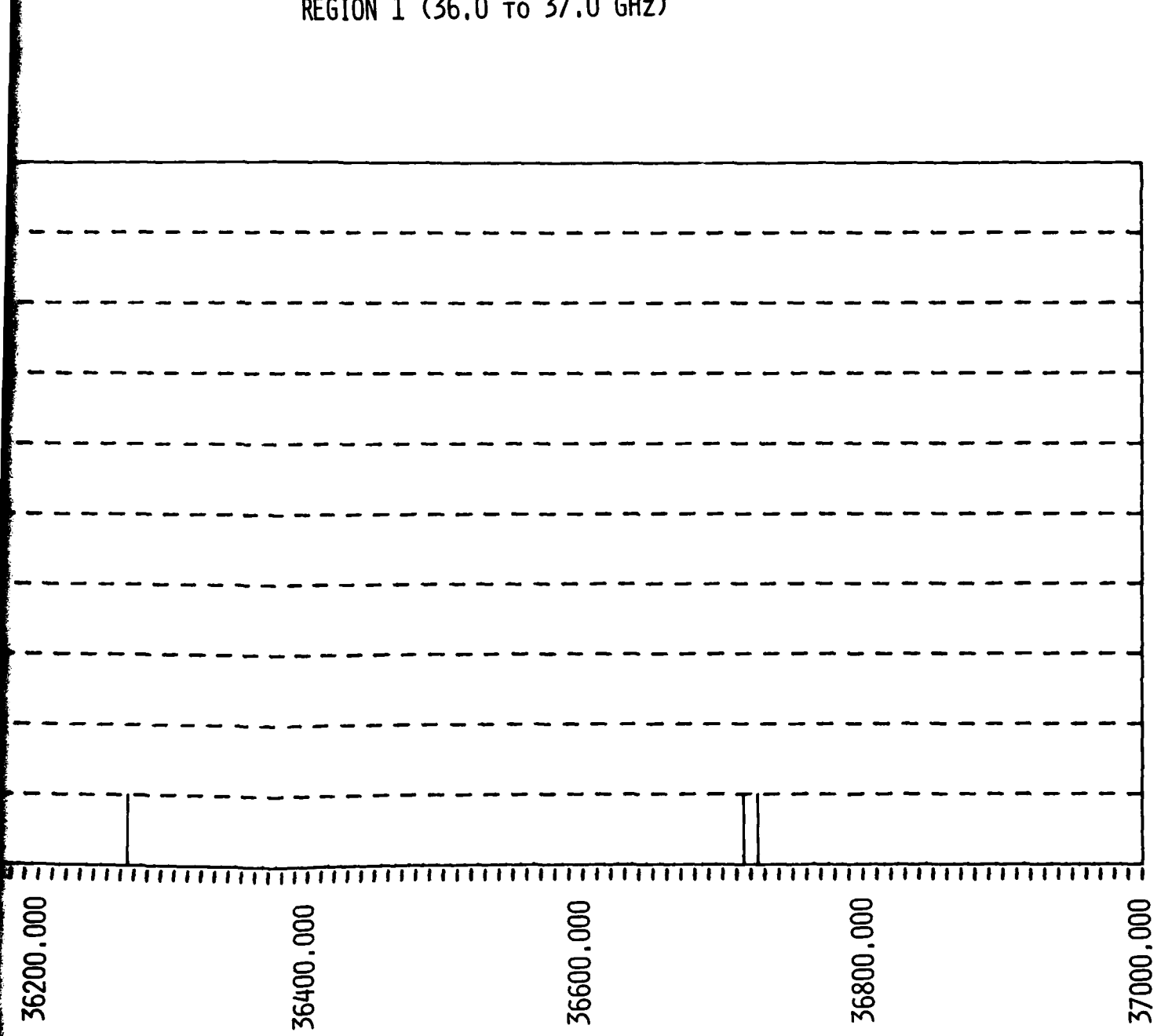

REGION 1 (36.0 TO 37.0 GHz)
36200.000
36400.000
36600.000
36800.000
37000.000
FREQUENCY (MHz)
4 EMITTERS PLOTTED

Figure 11.1

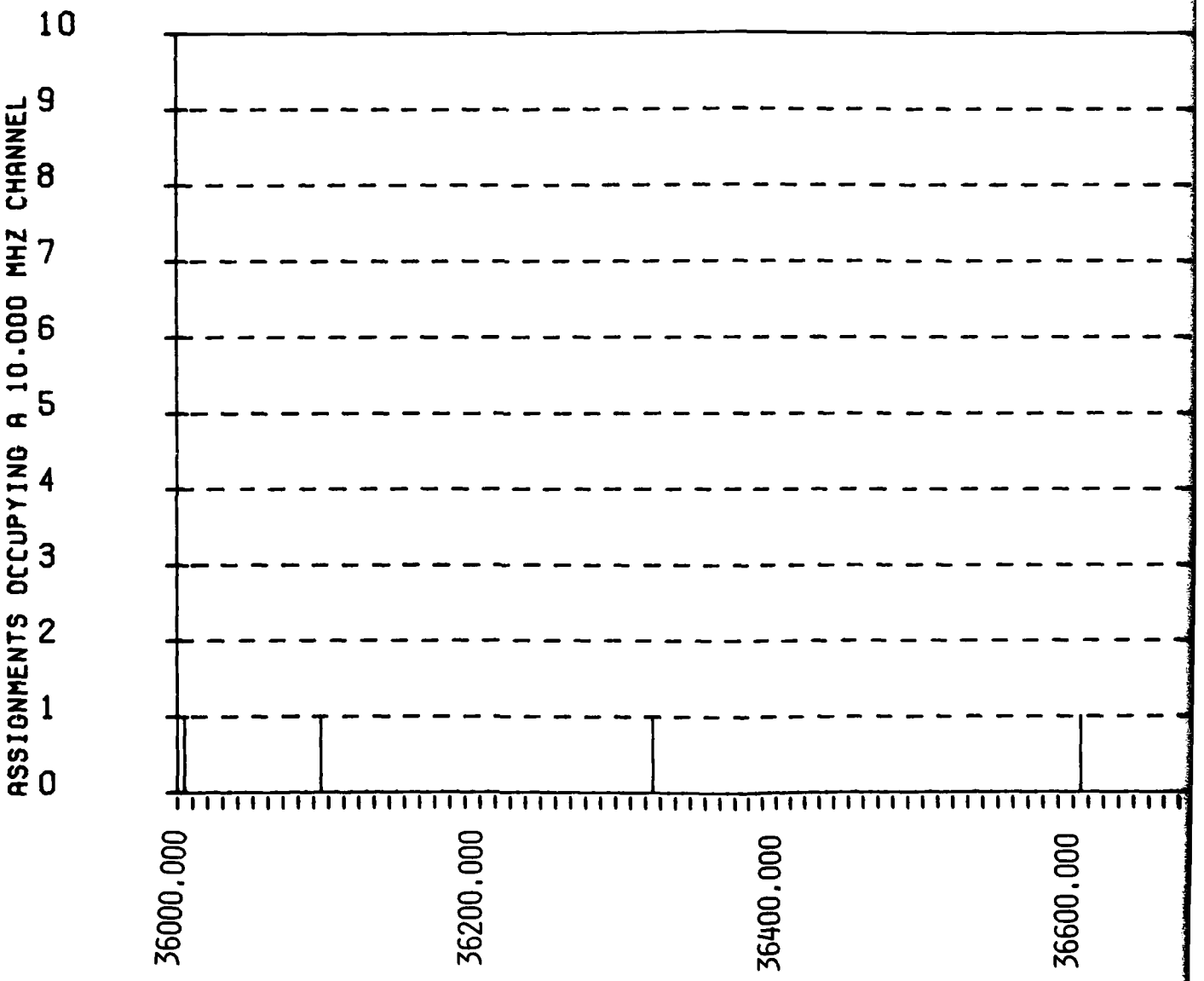

REGION 2 (36.0 TO 37.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
36000.000
36200.000
36400.000
36600.000
FREQUENCY (MHz)
21 EMITTERS PLOTTED

Figure 11.2

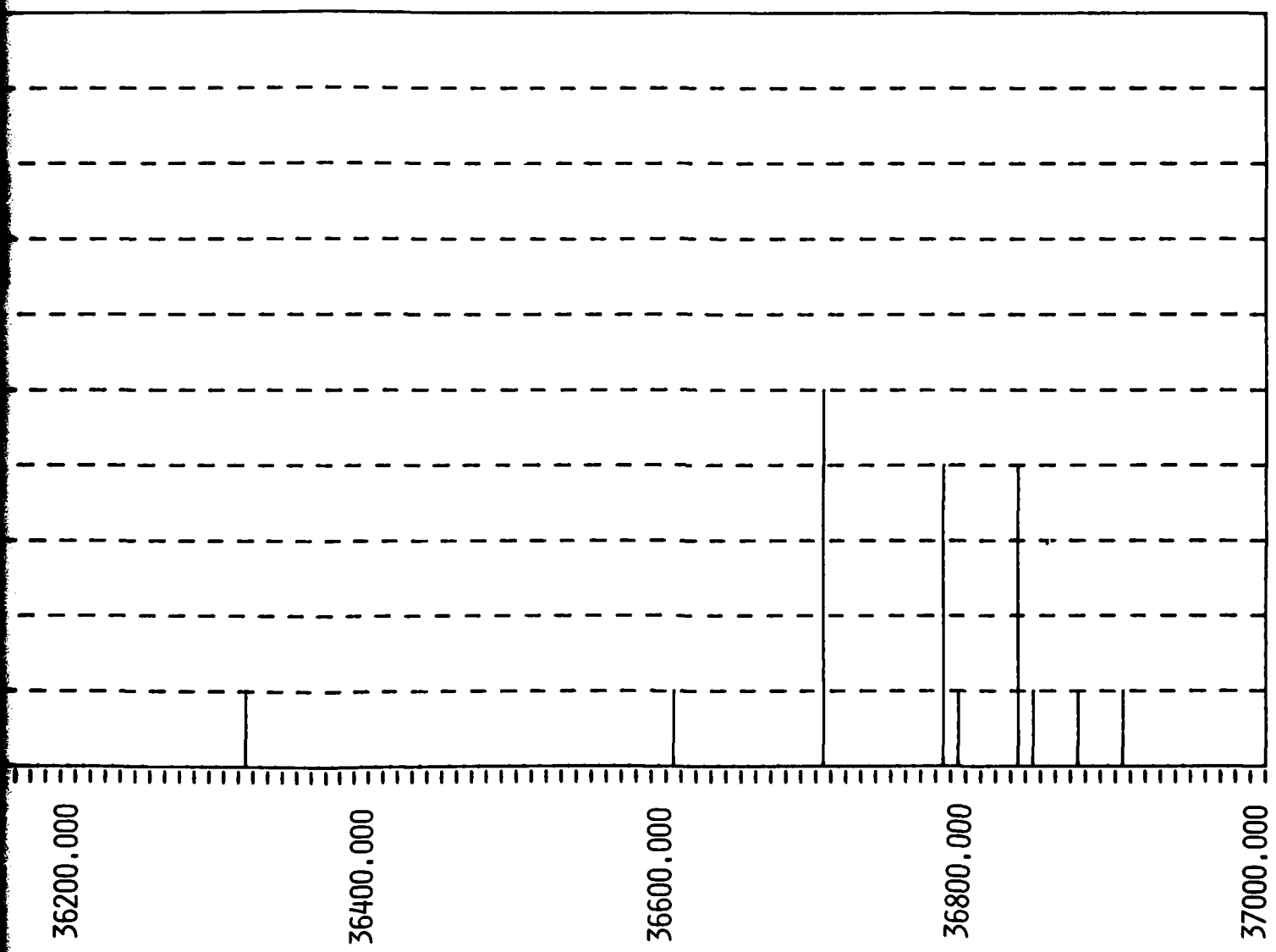

REGION 2 (36.0 TO 37.0 GHz)
36200.000
36400.000
36600.000
36800.000
37000.000
FREQUENCY (MHz)
21 EMITTERS PLOTTED

Figure 11.2

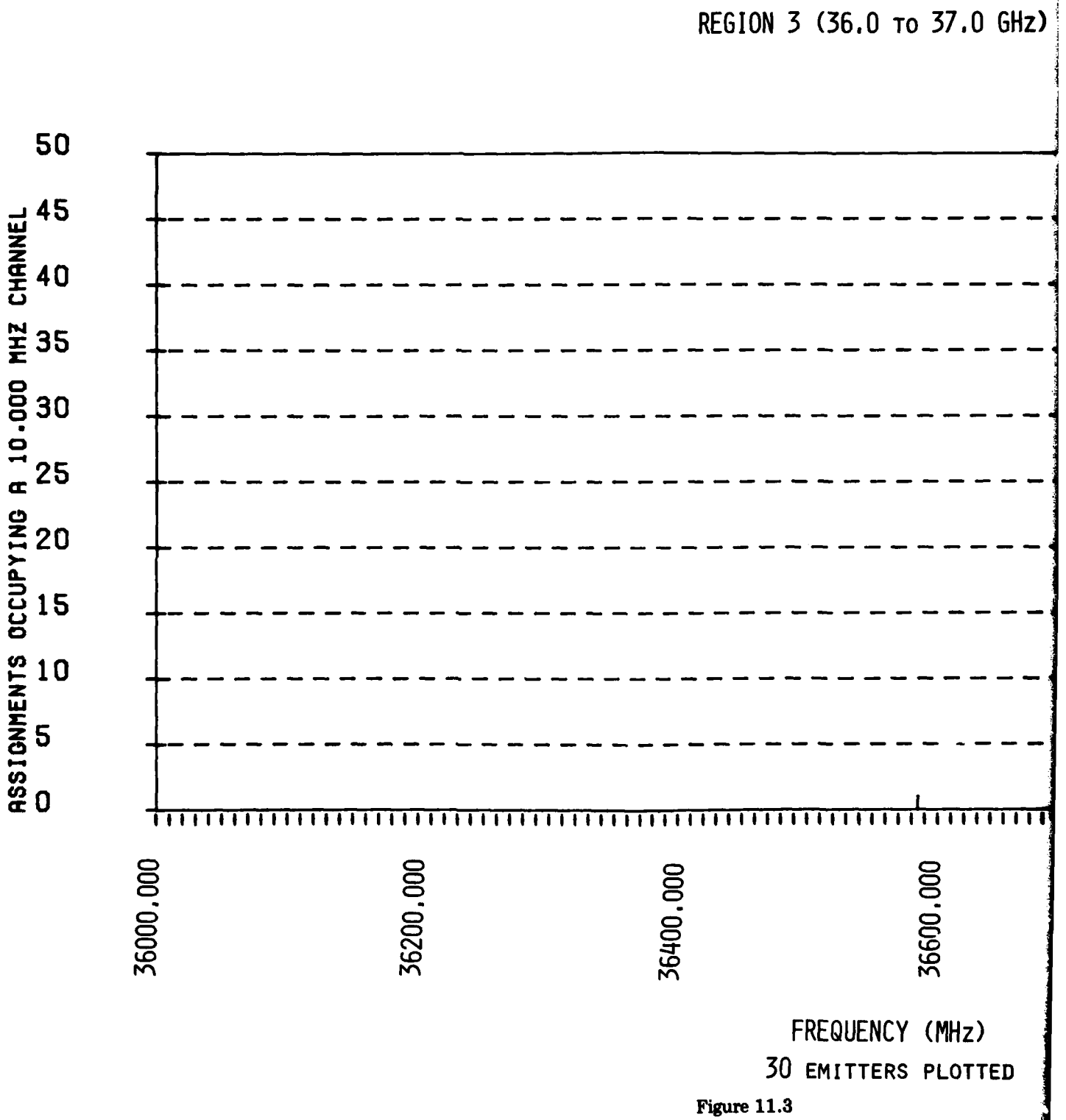

REGION 3 (36.0 TO 37.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
36000.000
36200.000
36400.000
36600.000
FREQUENCY (MHz)
30 EMITTERS PLOTTED

Figure 11.3

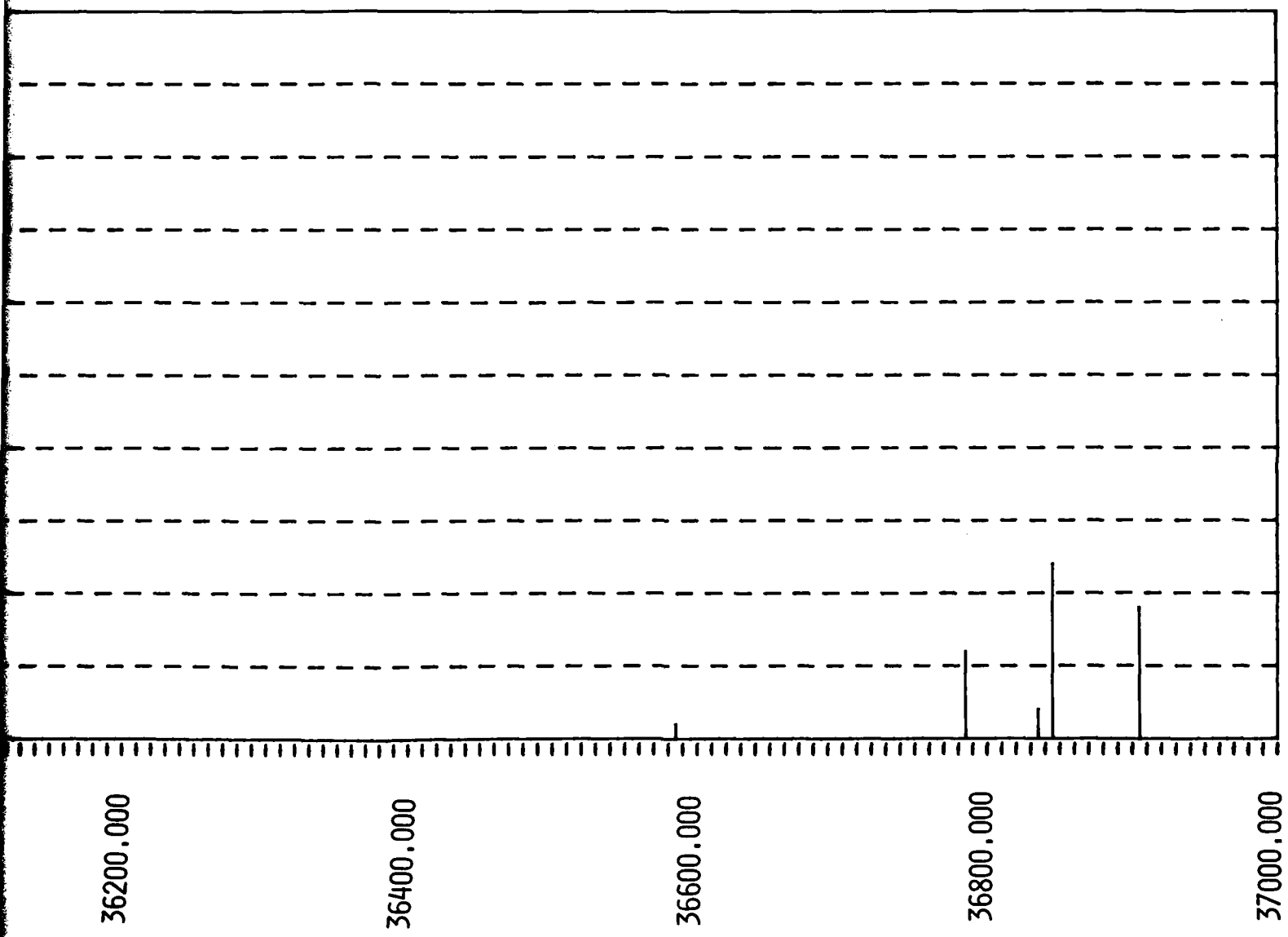

REGION 3 (36.0 TO 37.0 GHz)
36200.000
36400.000
36600.000
36800.000
37000.000
FREQUENCY (MHz)
30 EMITTERS PLOTTED

Figure 11.3

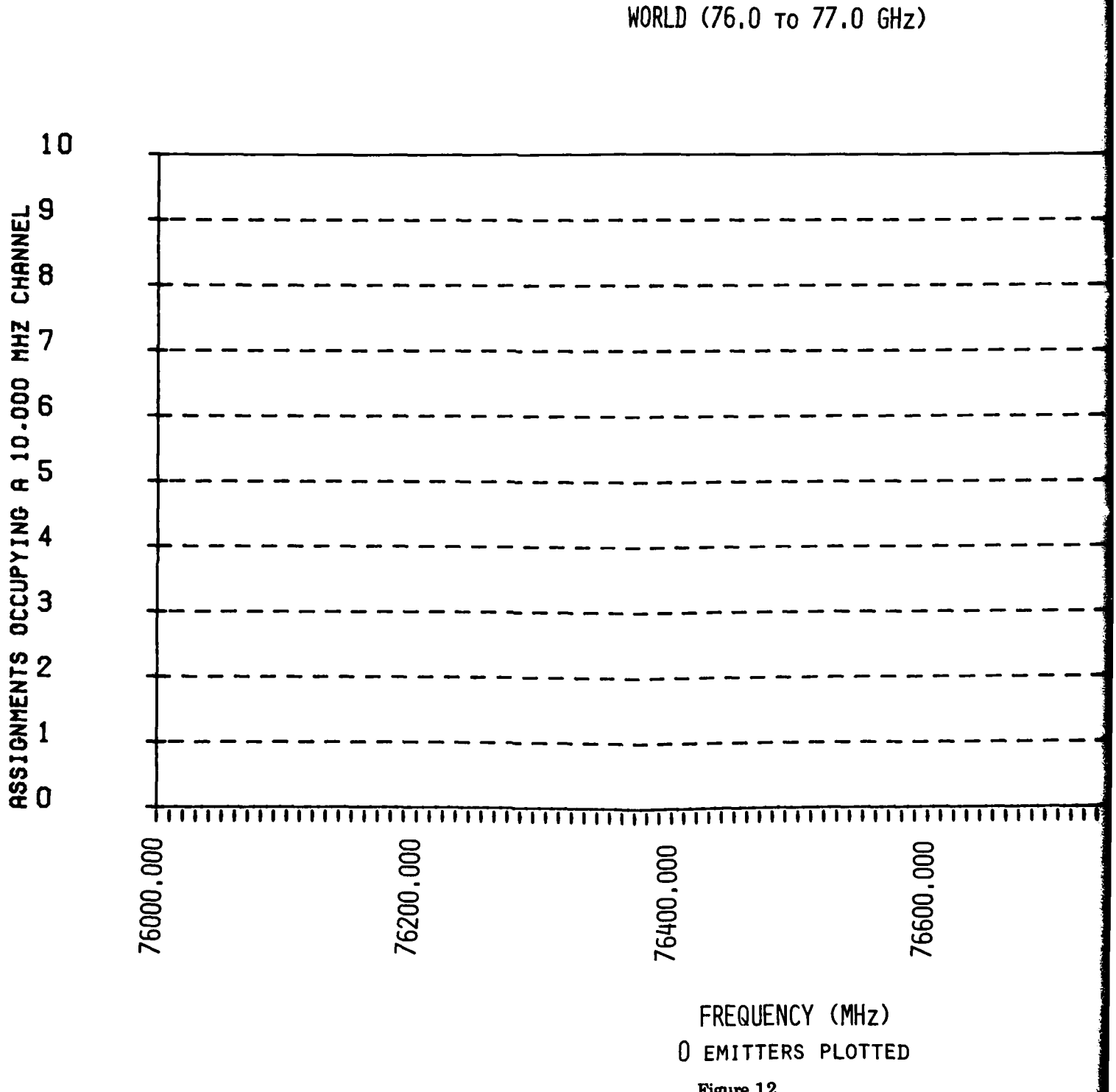

WORLD (76.0 TO 77.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
76000.000
76200.000
76400.000
76600.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 12

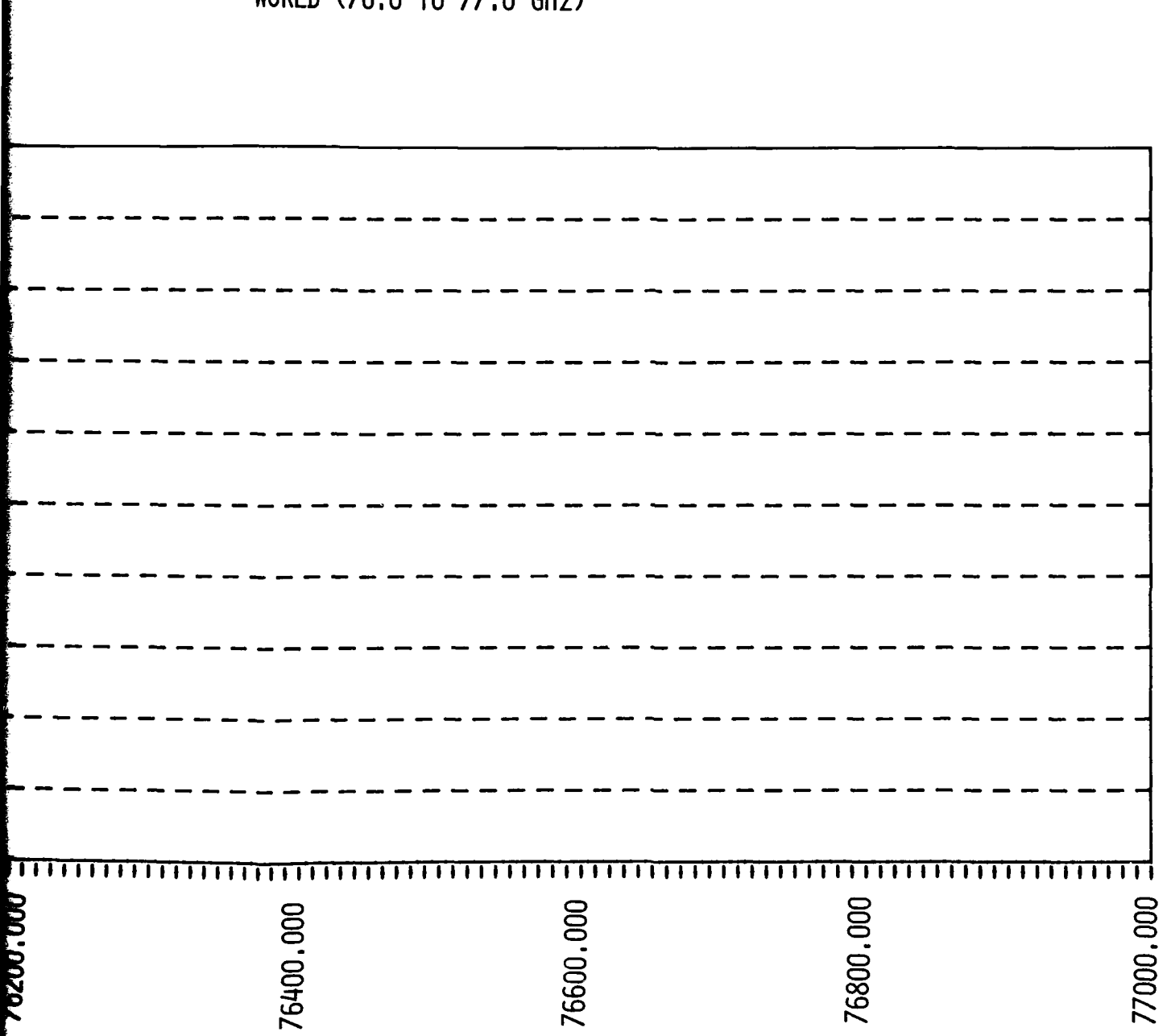

WORLD (76.0 TO 77.0 GHz)
76200.000
76400.000
76600.000
76800.000
77000.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 12

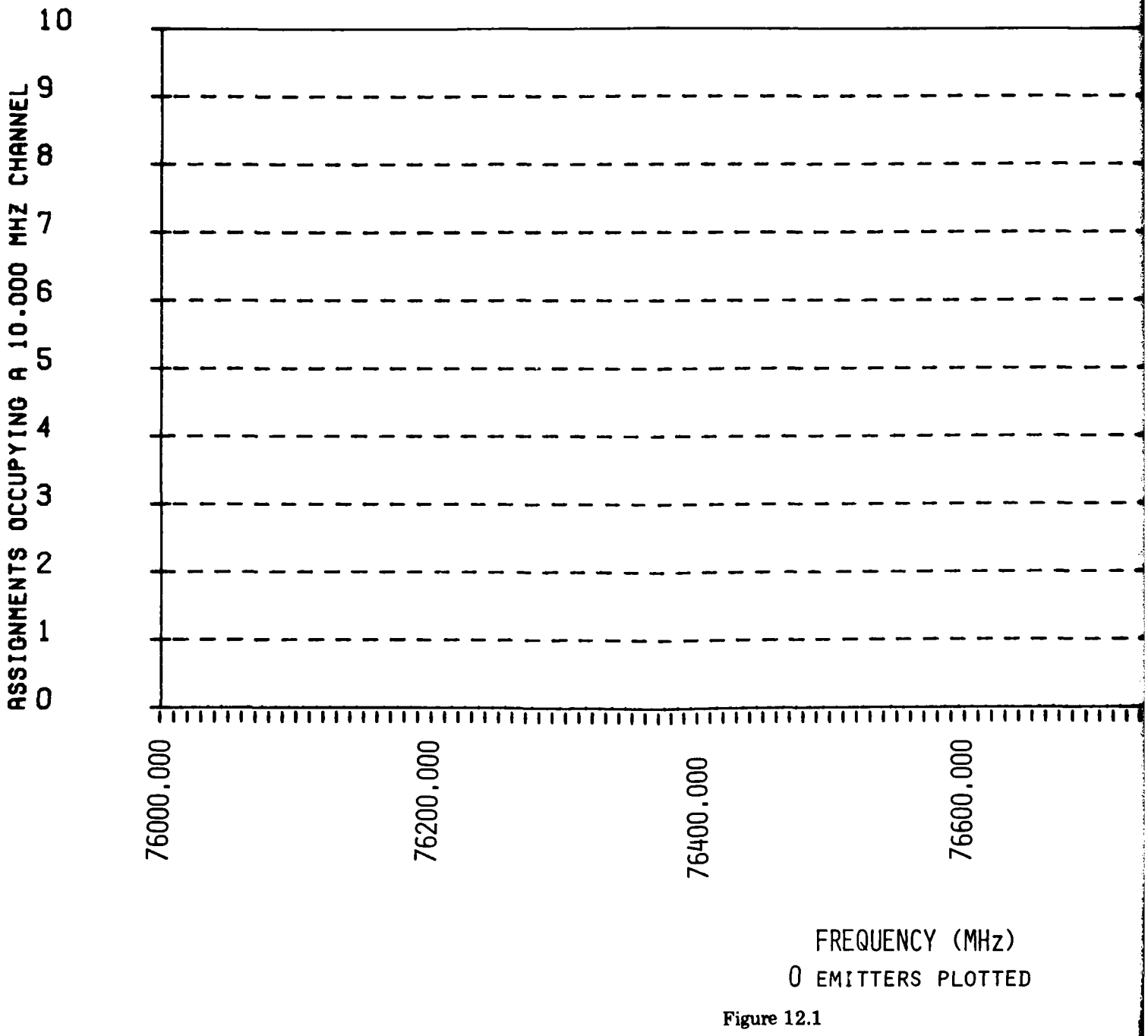

REGION 1 (76.0 TO 77.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
76000.000
76200.000
76400.000
76600.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 12.1

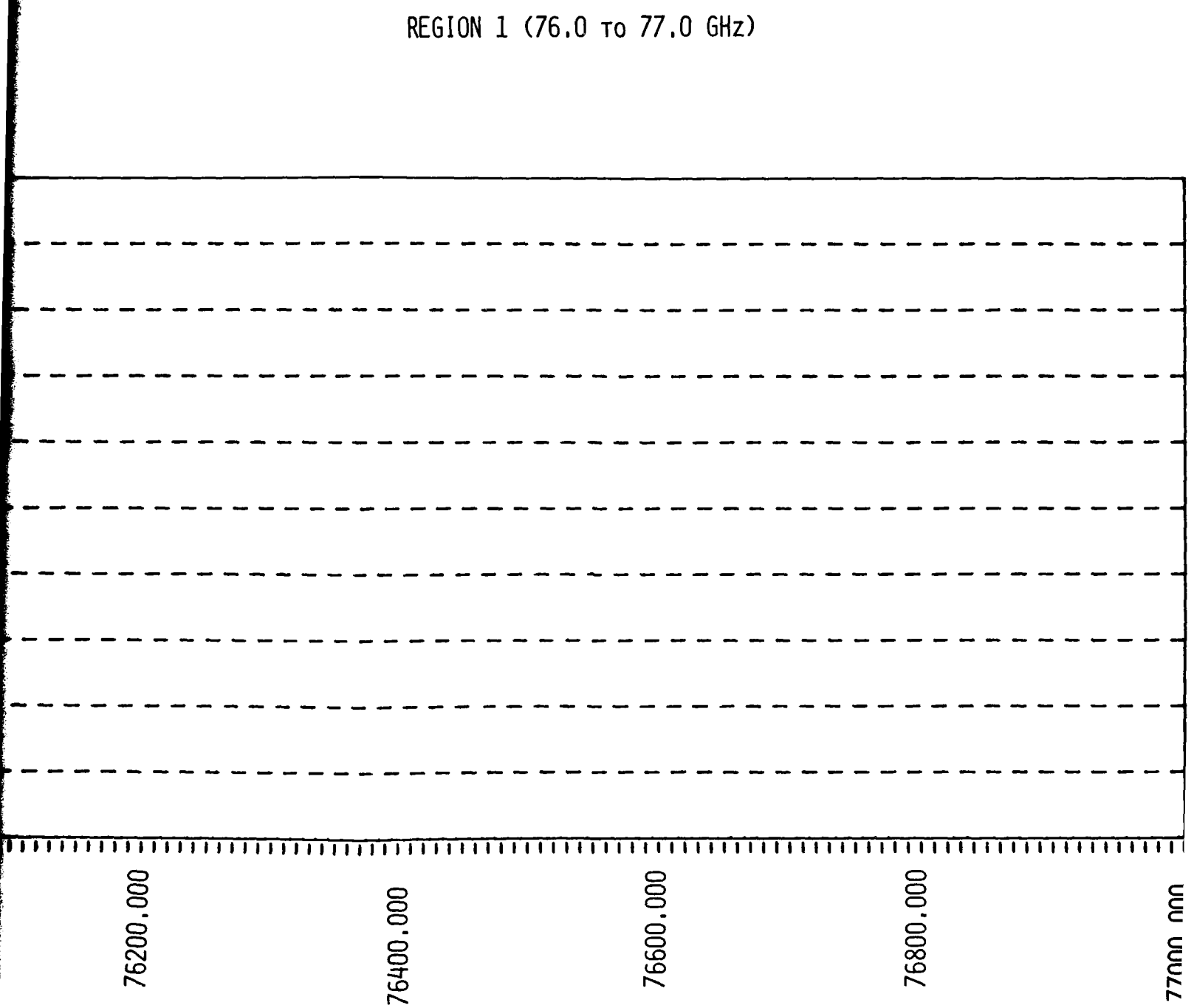

REGION 1 (76.0 TO 77.0 GHz)
76200.000
76400.000
76600.000
76800.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 12.1

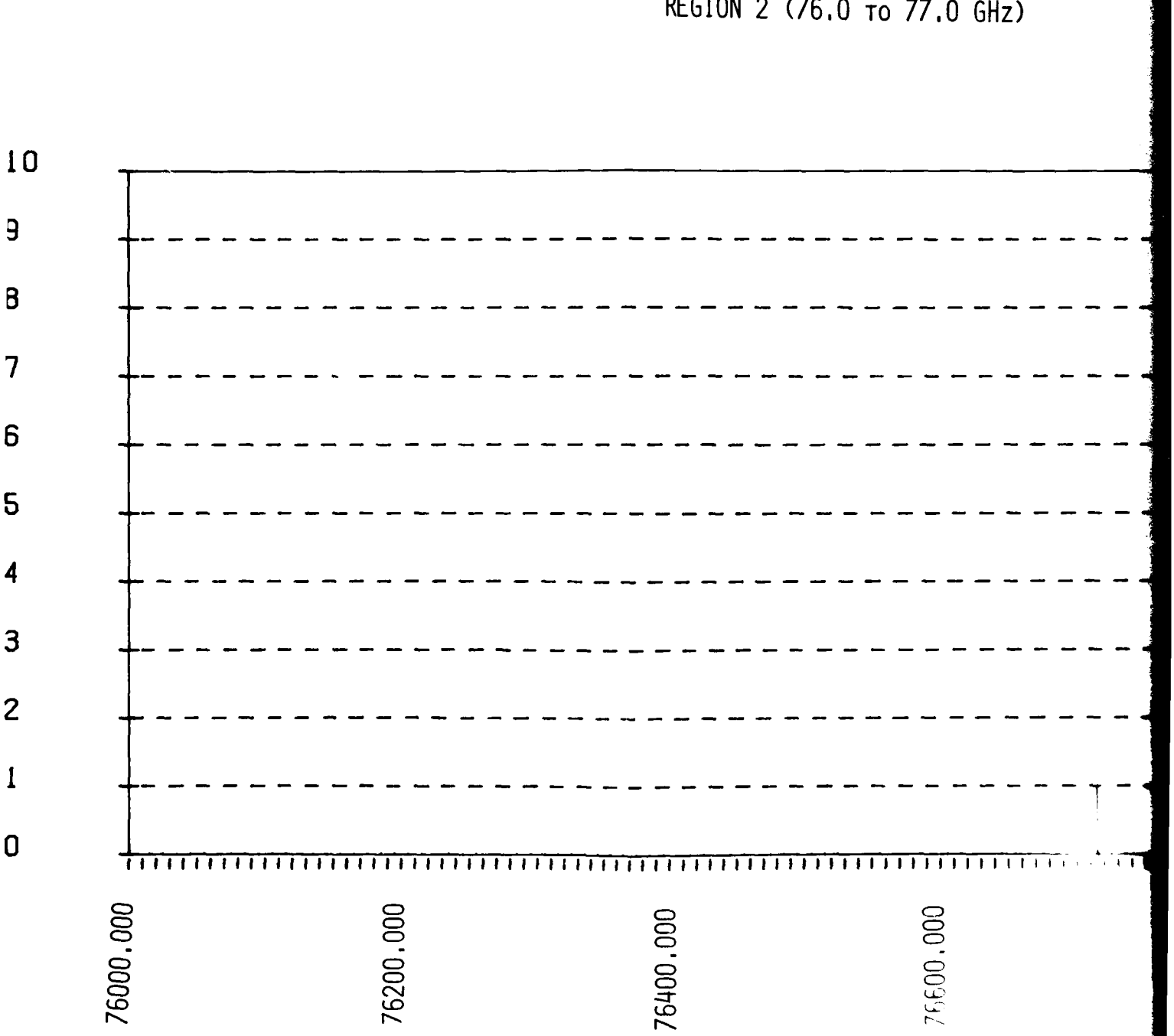
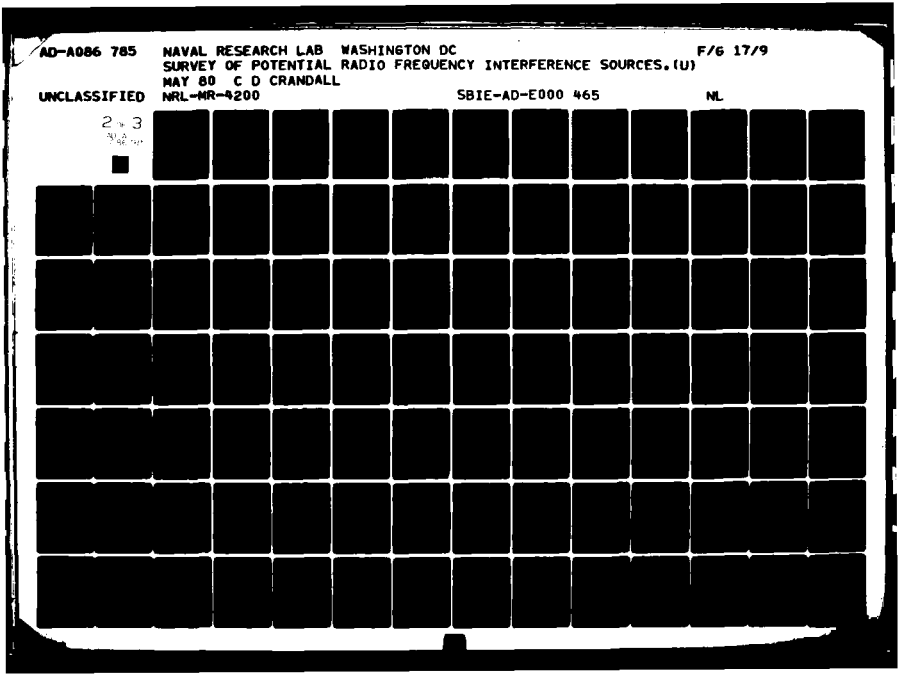
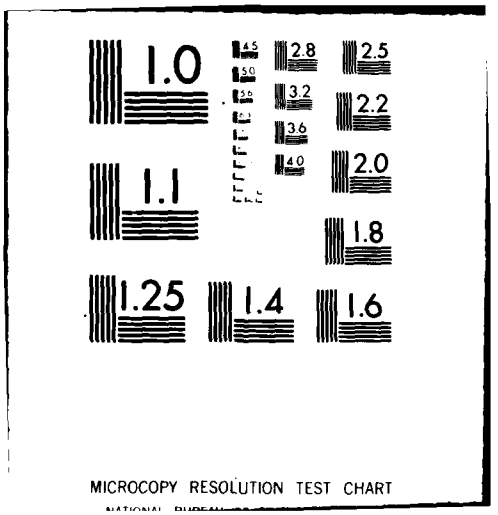

REGION 2 (76.0 TO 77.0 GHz)
10
9
8
7
6
5
4
3
2
1
0
76000.000
76200.000
76400.000
76600.000
FREQUENCY
1 EMITTER

Figure 12.2


AD-A086 785
NAVAL RESEARCH LAB WASHINGTON DC
F/6 17/9
SURVEY OF POTENTIAL RADIO FREQUENCY INTERFERENCE SOURCES.(U)
MAY 80 C D CRANDALL
UNCLASSIFIED
NRL-MR-4200
SBIE-AD-E000 465
NL
2 3


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART

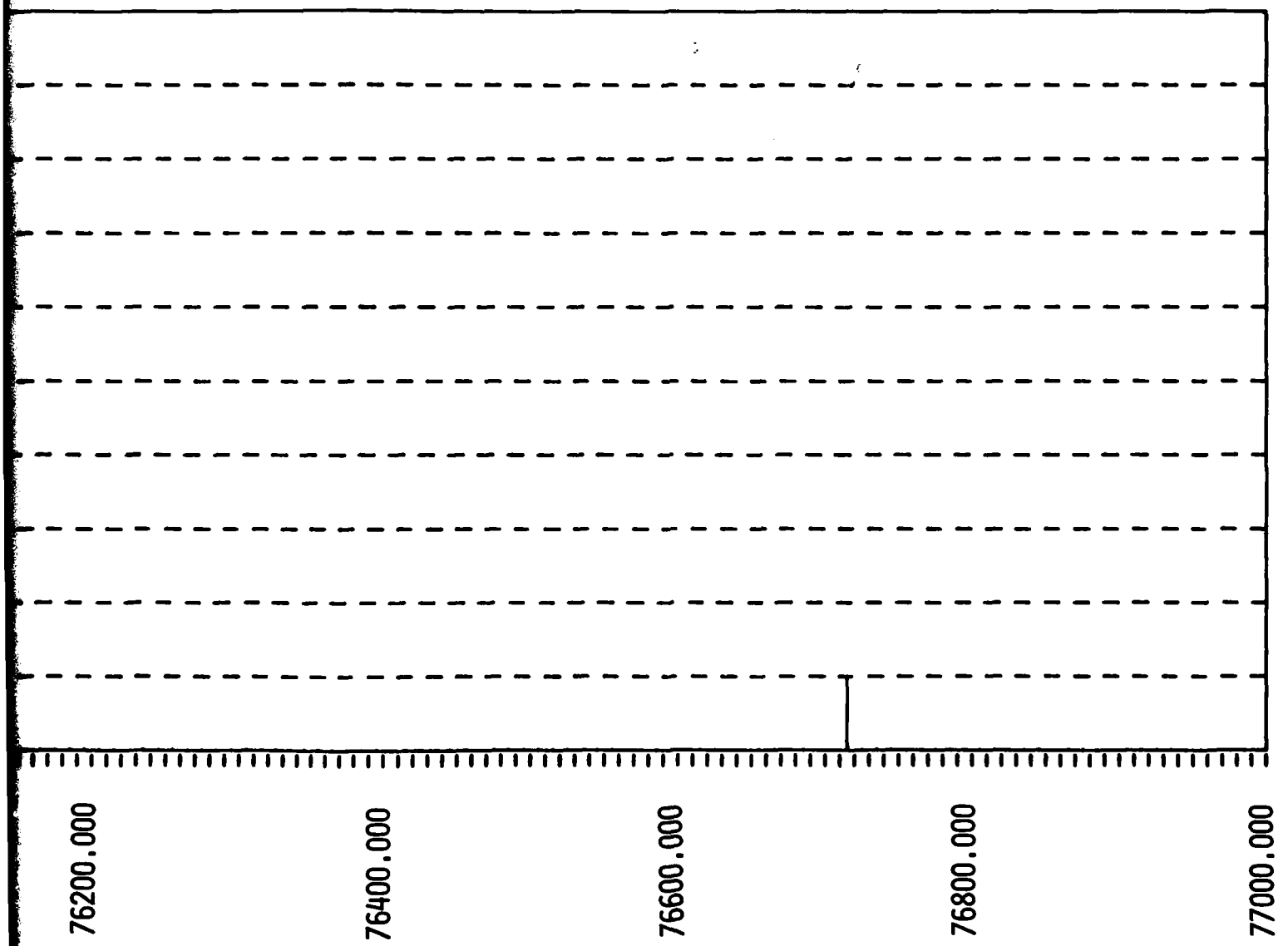

REGION 2 (76.0 TO 77.0 GHz)
76200.000
76400.000
76600.000
76800.000
77000.000
FREQUENCY (MHz)
1 EMITTER PLOTTED

Figure 12.2

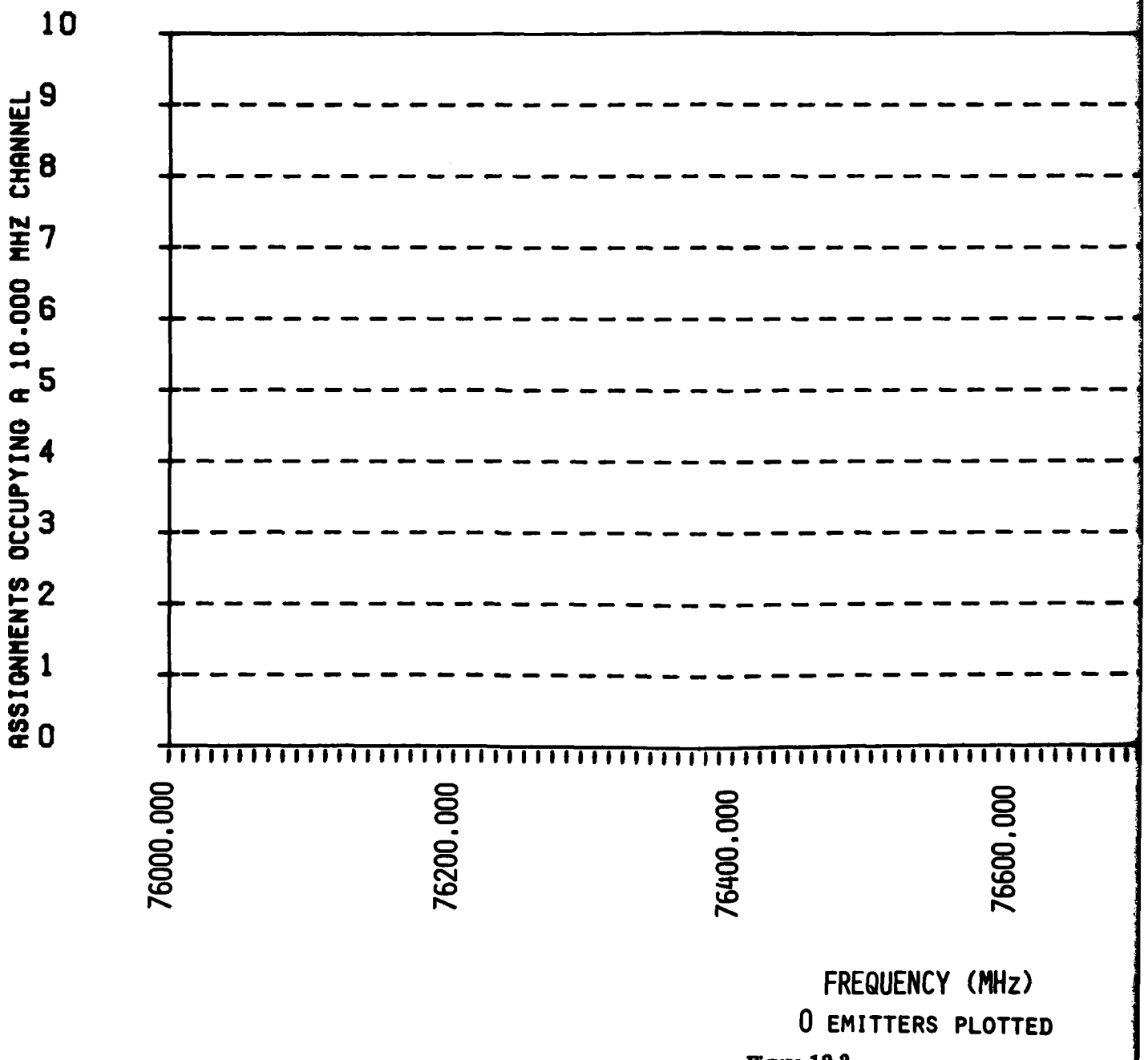

REGION 3 (76.0 TO 77.0 GHz)
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
76000.000
76200.000
76400.000
76600.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 12.3

REGION 3 (76.0 TO 77.0 GHz)

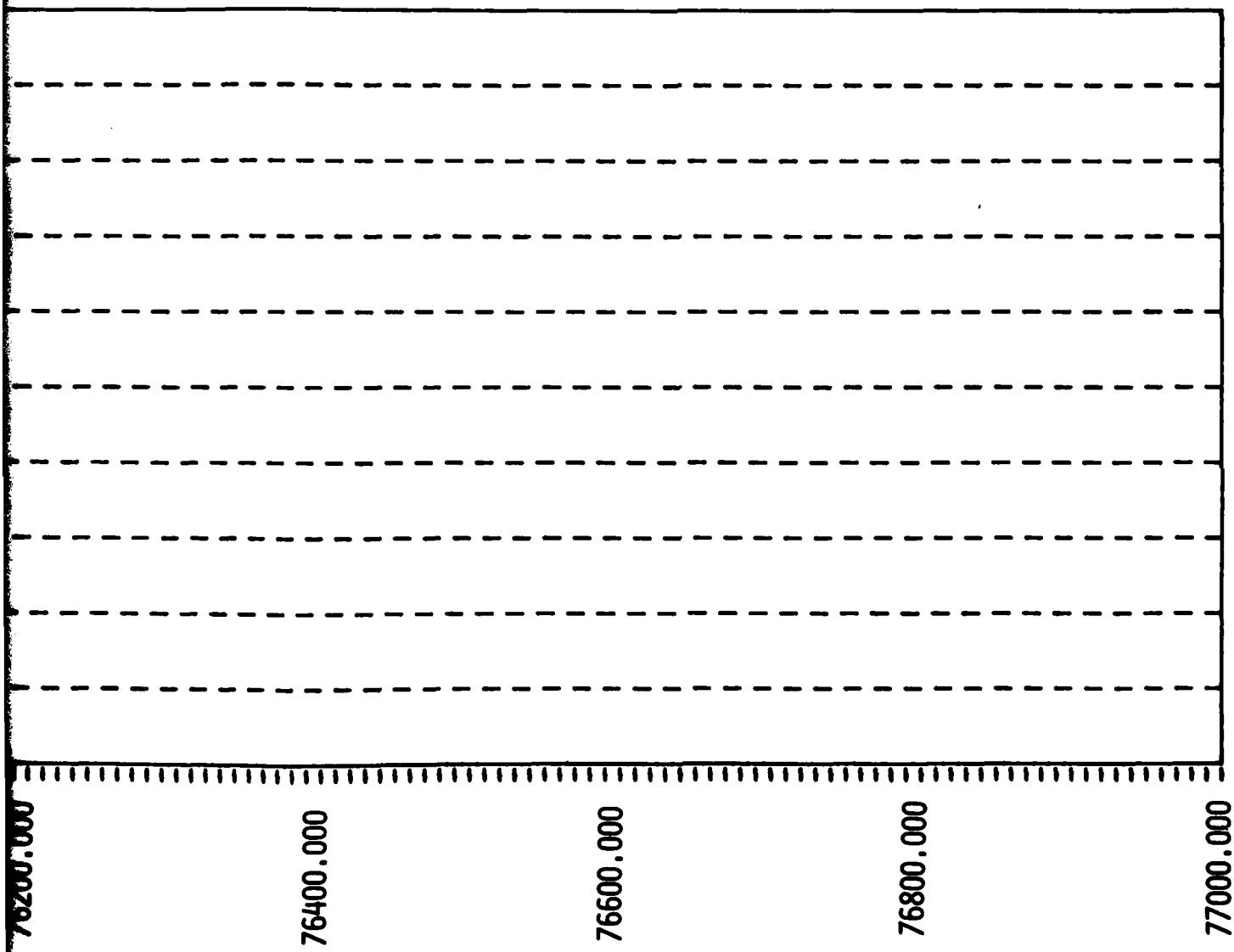


Figure 12.3

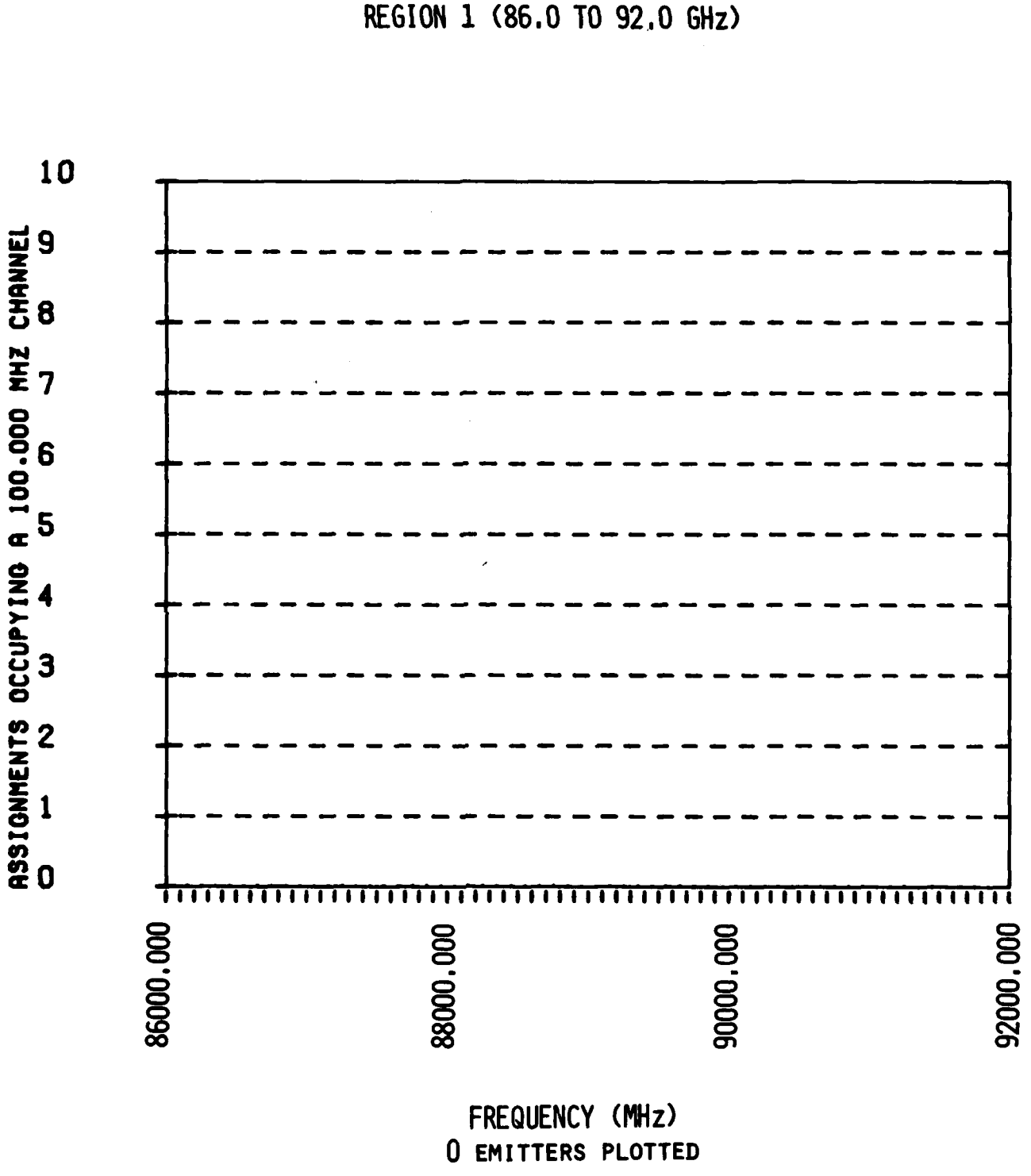

REGION 1 (86.0 TO 92.0 GHz)
ASSIGNMENTS OCCUPYING A 100.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
86000.000
88000.000
90000.000
92000.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 13.1

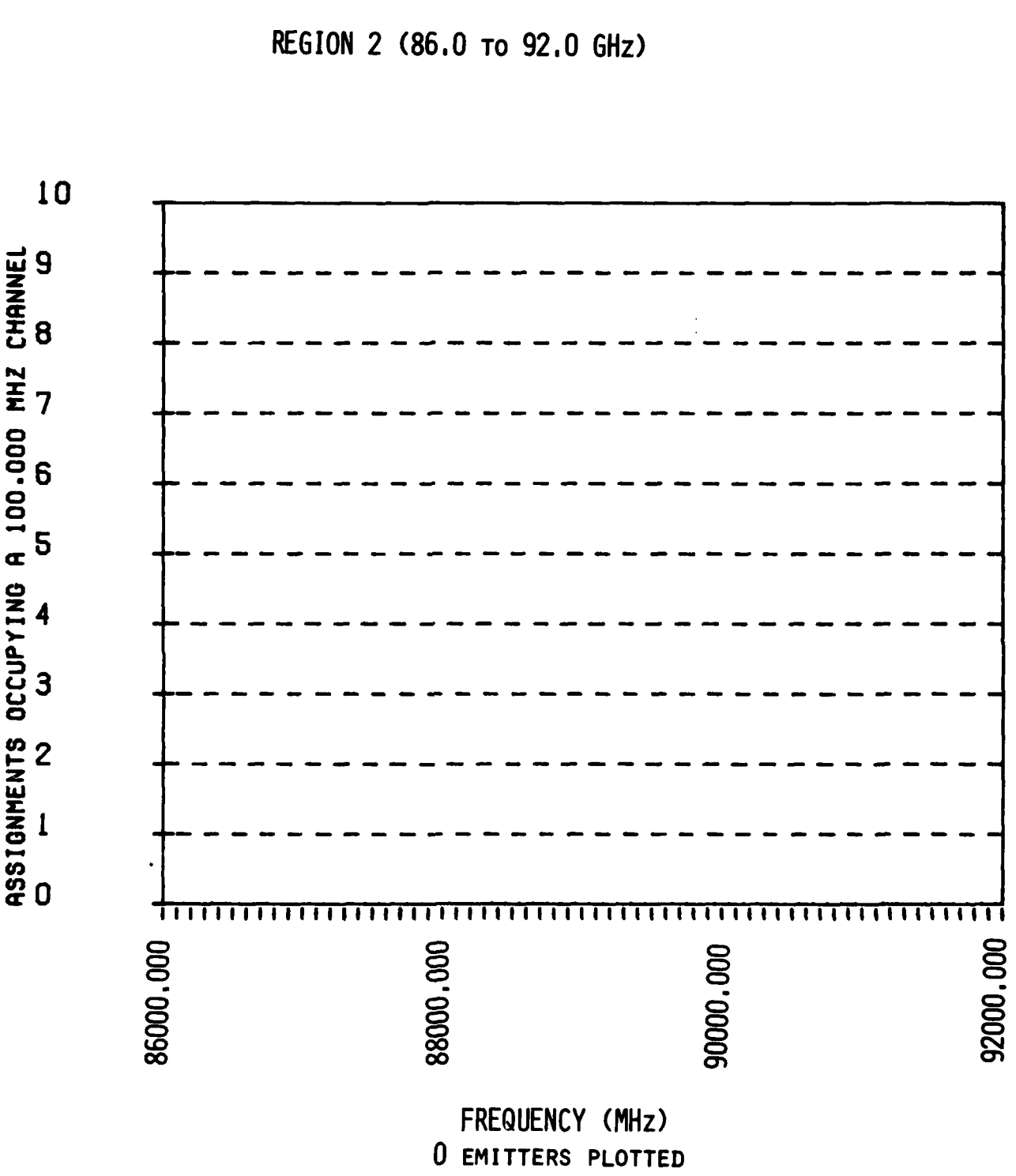

REGION 2 (86.0 TO 92.0 GHz)
ASSIGNMENTS OCCUPYING A 100.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
86000.000
88000.000
90000.000
92000.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 13.2

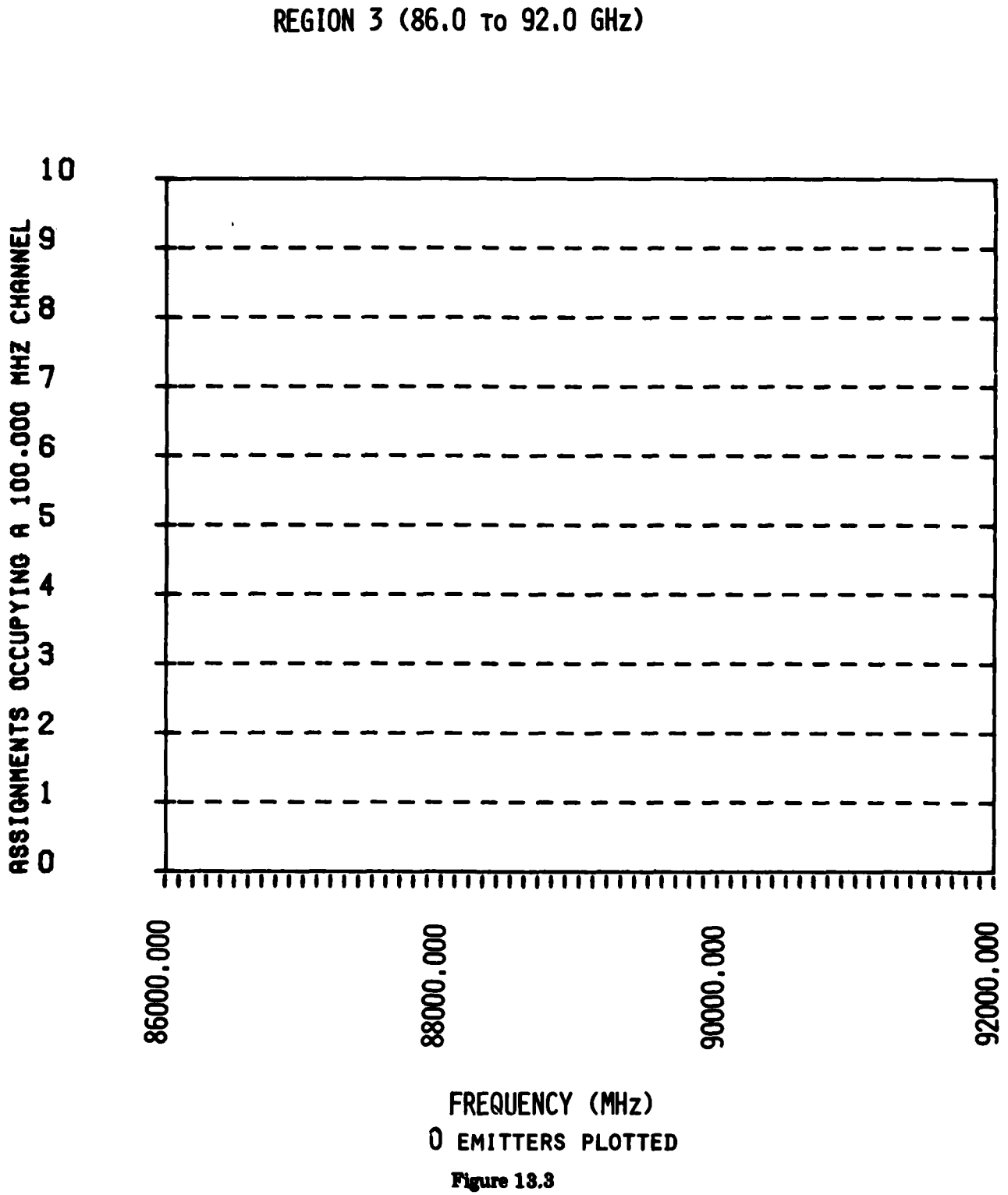

REGION 3 (86.0 TO 92.0 GHz)
ASSIGNMENTS OCCUPYING A 100.000 MHZ CHANNEL
10
9
8
7
6
5
4
3
2
1
0
86000.000
88000.000
90000.000
92000.000
FREQUENCY (MHz)
0 EMITTERS PLOTTED

Figure 13.3

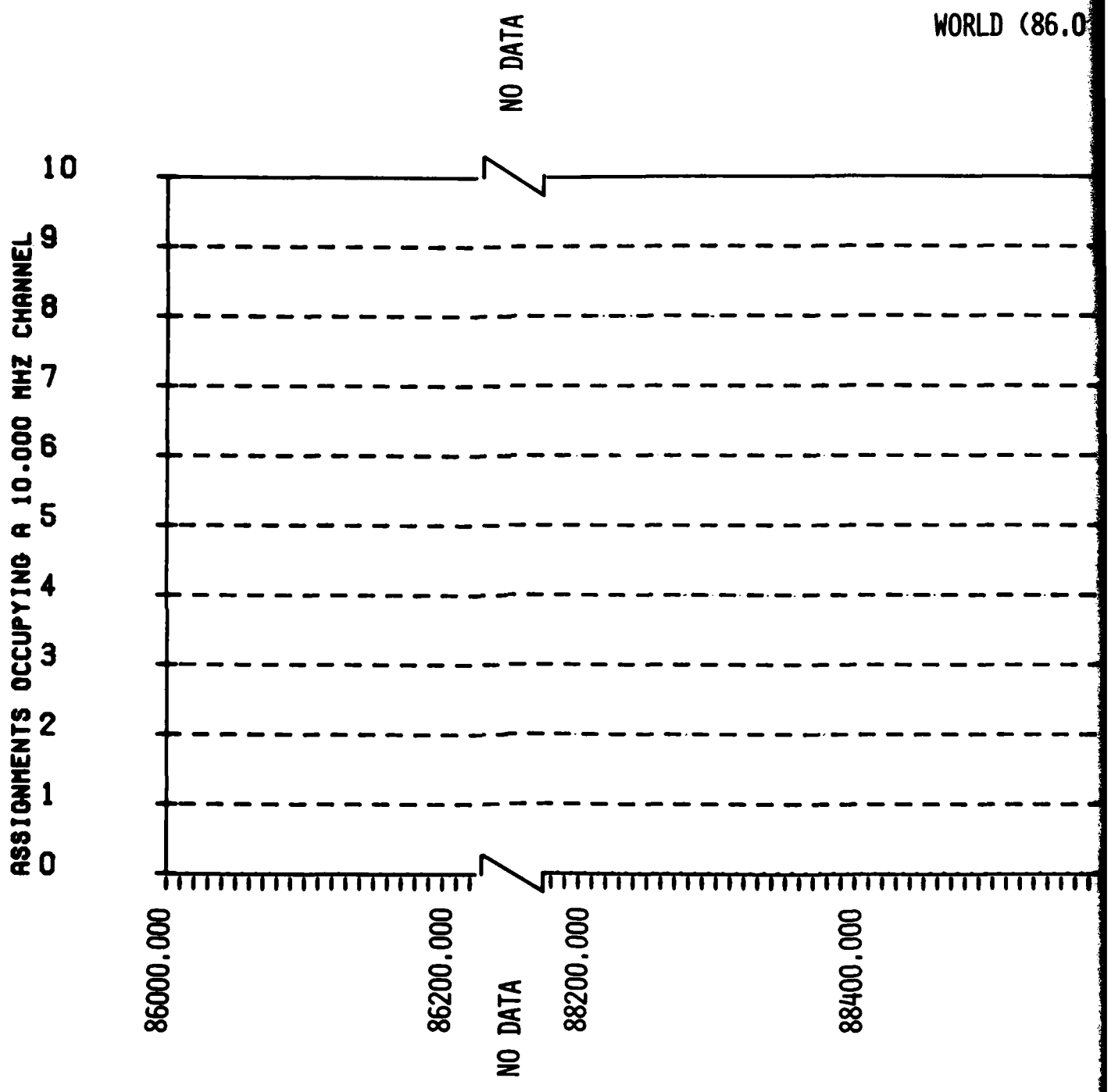

WORLD (86.0
NO DATA
10
9
8
7
6
5
4
3
2
1
0
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
86000.000
86200.000
NO DATA
88200.000
88400.000
FREQUENCY (
1 EMITTER PL

Figure 1

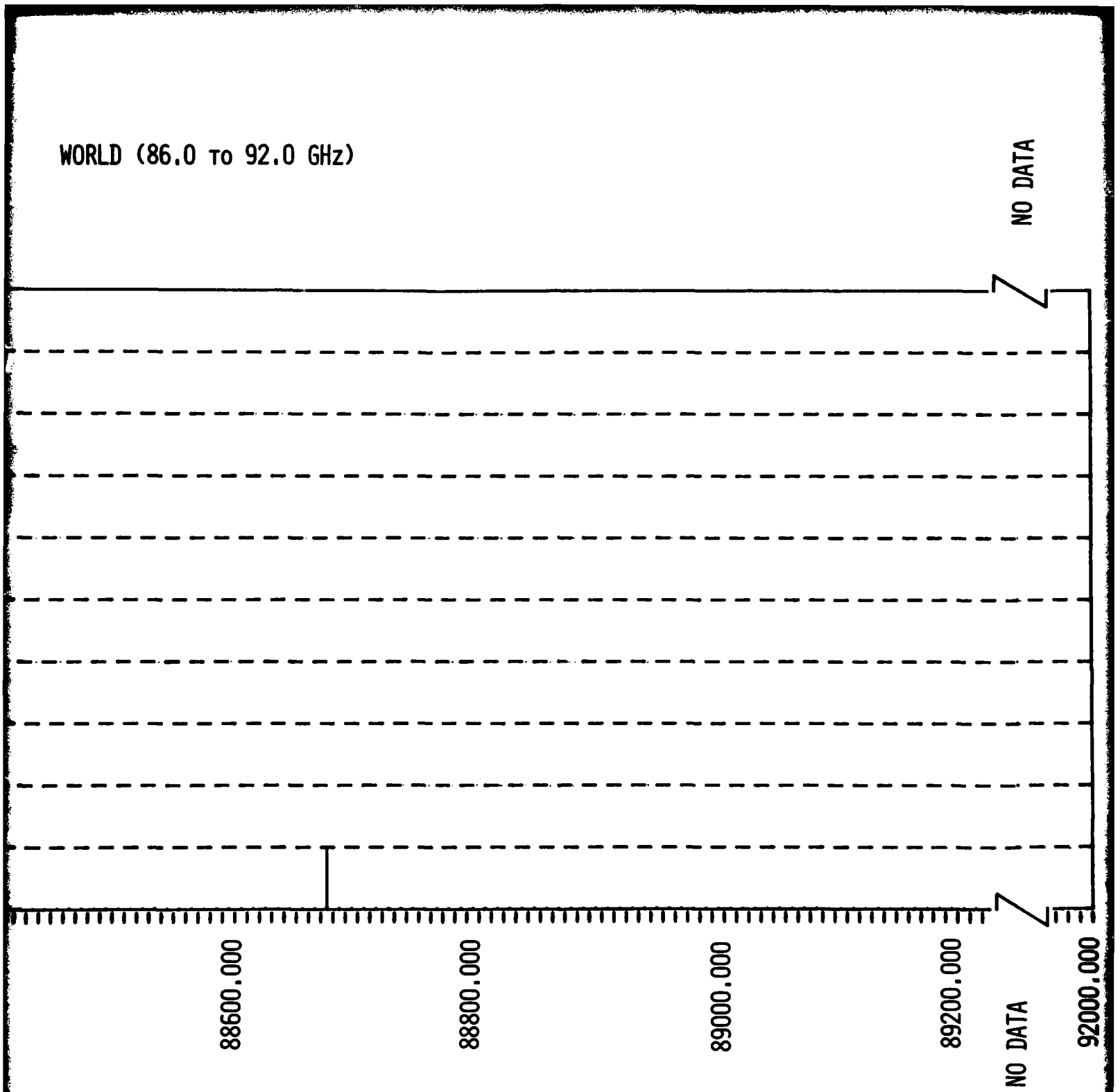

WORLD (86.0 TO 92.0 GHz)
NO DATA
88600.000
88800.000
89000.000
89200.000
NO DATA
92000.000
FREQUENCY (MHz)
1 EMITTER PLOTTED

Figure 13

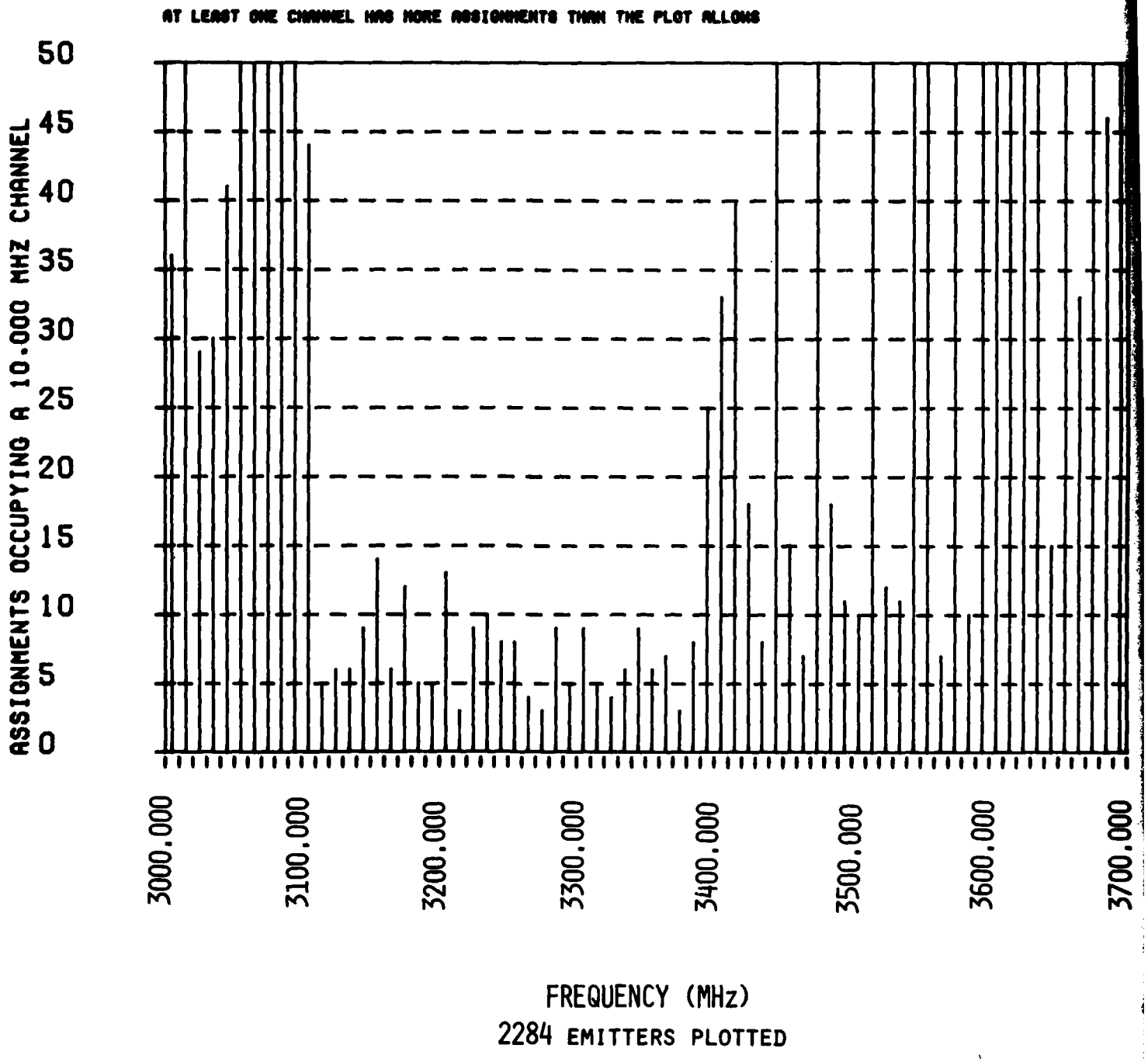
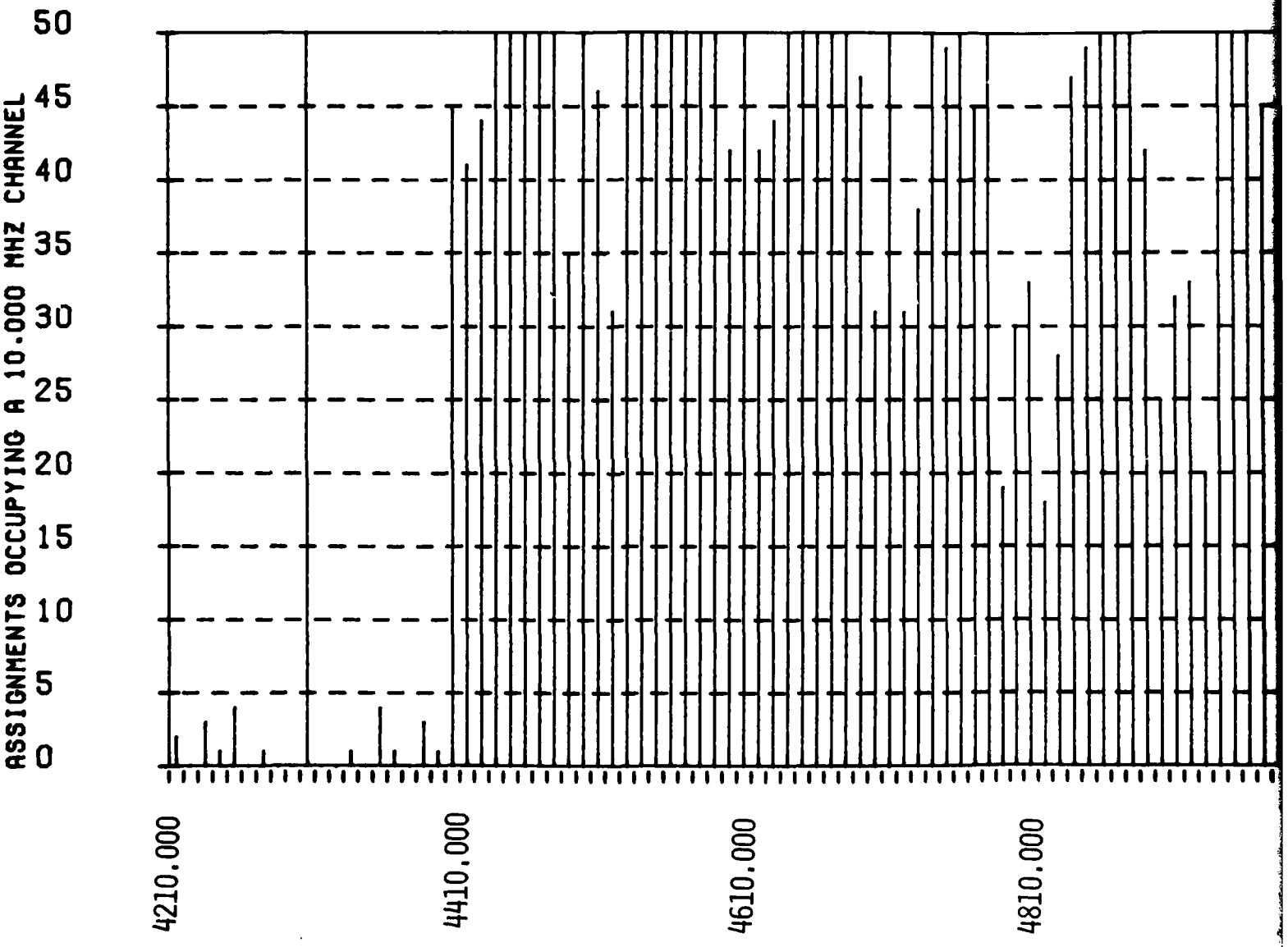
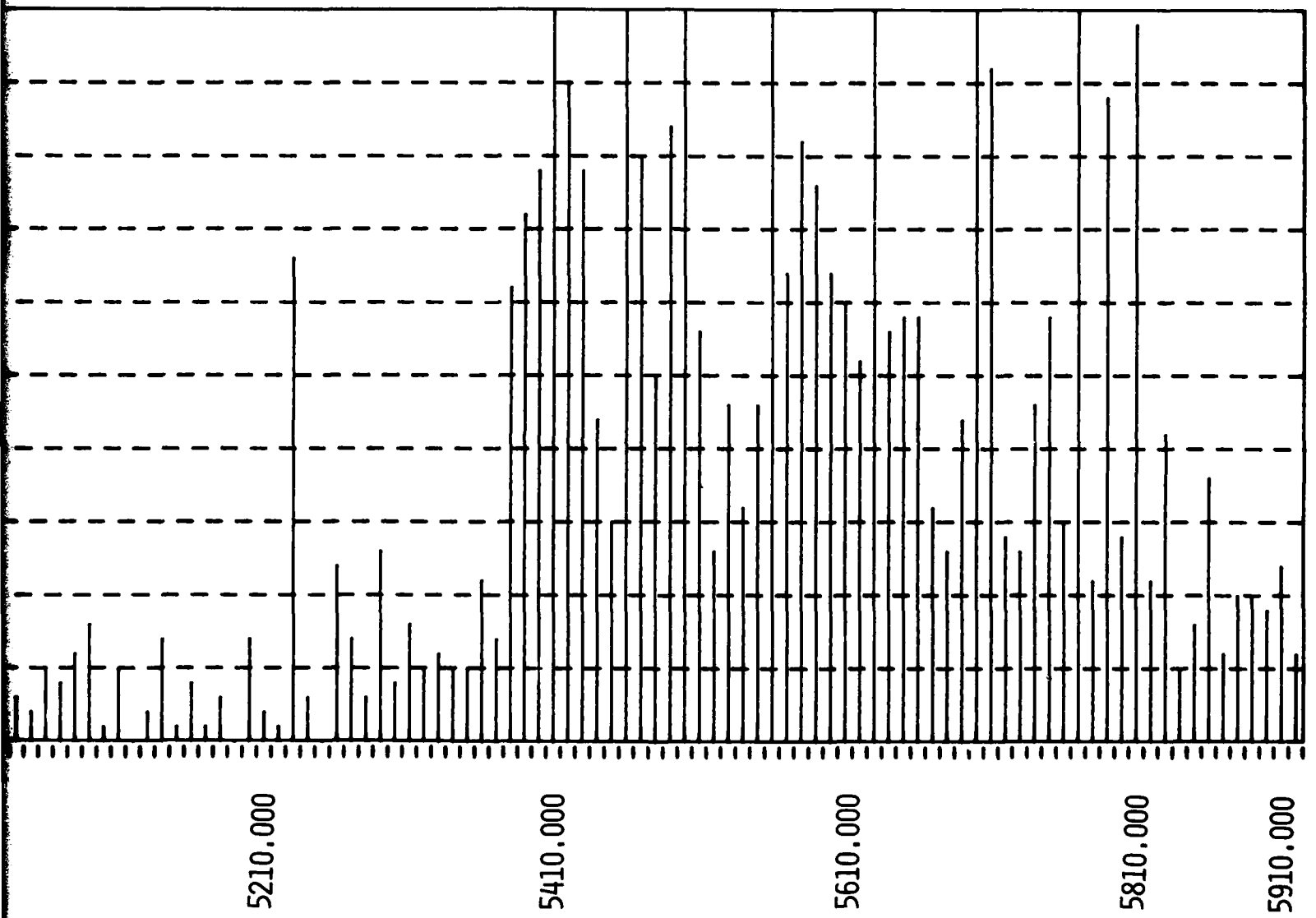

WORLD (3.0 TO 3.7 GHz)
AT LEAST ONE CHANNEL HAS MORE ASSIGNMENTS THAN THE PLOT ALLOWS
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
3000.000
3100.000
3200.000
3300.000
3400.000
3500.000
3600.000
3700.000
FREQUENCY (MHz)
2284 EMITTERS PLOTTED

Figure 14

WORLD


AT LEAST ONE CHANNEL HAS MORE ASSIGNMENTS THAN THE PLOT ALLOWS
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
4210.000
4410.000
4610.000
4810.000

TO 5.91 GHz)



UENCY (MHz)

ITTERS PLOTTED

5

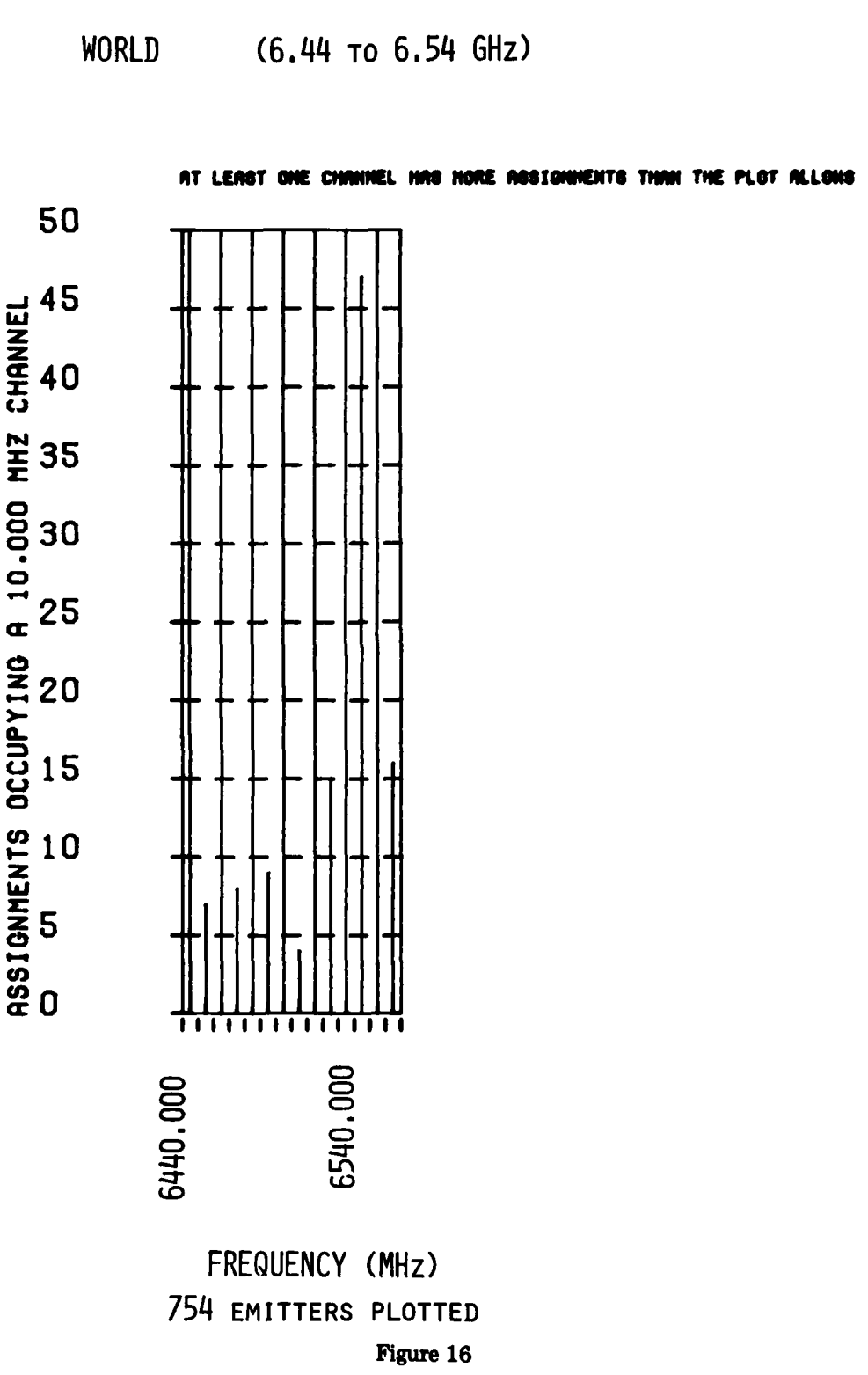

WORLD (6.44 TO 6.54 GHz)
AT LEAST ONE CHANNEL HAS MORE ASSIGNMENTS THAN THE PLOT ALLOWS
ASSIGNMENTS OCCUPYING A 10.000 MHZ CHANNEL
50
45
40
35
30
25
20
15
10
5
0
6440.000
6540.000
FREQUENCY (MHz)
754 EMITTERS PLOTTED

Figure 16

TABLE 1

TECHNICAL CHARACTERISTICS

• CLOCK INPUTS - 1 Hz, 10 kHz, 1.6 MHz, SATELLITE TIME					
• ENG AND SCI DATA RATE - 2 kbps					
• WEIGHT - 53 kg					
• PRIME POWER - 61 W (AVERAGE)					
• FREQUENCY, GHz	6.63	10.69	18	21	37
• ANTENNA DIAMETER, m	←		0.79		→
• ANTENNA BEAMWIDTH, HALF-POWER, deg	4.2	2.6	1.6	1.4	0.8
• POLARIZATION	←		DUAL LINEAR		→
• FOOTPRINT DIMENSIONS (MAJOR AXIS / MINOR AXIS), km	121 79	74 49	44 29	38 25	21 14
• FULL SWATH ANGLE, deg	←		50		→
• SWATH ARC WIDTH, km	←		659		→
• INCIDENCE ANGLE OF BEAM CENTER AT SURFACE, deg	←		48.8		→
• ORBITAL ALTITUDE, km	←		794		→
• RF BANDWIDTH, MHz	←		250		→
• DISSIPATIVE LOSSES:					
(ORTHOMODE TRANSDUCER WAVEGUIDES SWITCHES AND ISOLATOR) dB	0.55 0.25 0.6	0.37 0.34 0.6	0.52 0.25 0.6	1.03 0.2 0.7	0.3 0.2 0.7
TOTAL DISSIPATIVE LOSSES, dB	1.4	1.21	1.37	1.93	1.2
• NOISE FIGURE (MIXER + 1F AMP), DSB, dB	4	4	5	5	5
• SYSTEM NOISE TEMPERATURE (REFERRED TO PORT OF MODULATOR), DSB, K	490	490	692	703	728
• PREDETECTION BANDWIDTH, MHz	←		100		→
• INTEGRATION TIME CONSTANT, milliseconds	126	62	62	62	30
• TEMPERATURE RESOLUTION, K (1σ) (300K TARGET)	0.51	0.72	0.89	1.01	1.23
• ABSOLUTE TEMPERATURE ACCURACY, K (1σ)	←		2		→
• DYNAMIC TEMPERATURE RANGE, K	←		10-330		→

- PERFORMANCE
- OCEAN SURFACE WIND SPEED FROM 7 m to 50 m/sec $\pm$2 m/sec OR $\pm$10%, WHICHEVER IS GREATER
- OCEAN SURFACE TEMPERATURE TO WITHIN $\pm 2^{\circ}$C ABSOLUTE AND $\pm$0.5 C RELATIVE
- WIND AND TEMPERATURE RESOLUTION - 121 km
- ICE FIELD MAPS. RESOLUTION - 21 km
- MEASUREMENT OF INTEGRATED ATMOSPHERIC WATER VAPOR AND LIQUID MATTER IN A COLUMN ALONG THE SIGNAL VECTOR
- MEASUREMENT OF RAIN DROP SIZE AND DISTRIBUTION IN A COLUMN ALONG THE SIGNAL VECTOR

TABLE 2. LAMMR OPTIONS

	SEASAT	OPTION A	OPTION B	OPTION C	OPTION D
Antenna Aperture	0.8 m	4 m	3 m	4 m	2 m
Frequencies (GHz)	6.6, 10.7, 18, 21, 37	4.7, 10.65, 18.6, 21.3 36.5, 91	4.3, 10.65, 18.6, 21.3, 36.5, 91	6.6, 18.6, 21.3, 36.5 91	18, 22, 37, 91
Polarization	Dual (H, V)	Dual (H, V)	Dual (H, V)	V; H & V; H; V; H	H&V; H; V; H
Beam/Channel	Single	Single (Dual 91)	Single (Dual 91)	Single (Dual 91)	Single
Resolution (km)	150, 90, 53, 43, 27 (800 km)	36, 15, 9, 8, 7, 3.5	47, 21, 12, 11, 7, 3.5	23, 9, 8, 7, 3.5	18, 16, 14, 7
Incidence Angle	48.8°	50° (43.5)	50°	50°	50°
Scan	-3° +47° (right side)	360°	360°	360°	360°
Swath (km)	600	1350	1350	1350	1350
ΔT (°K T_B)	0.6, 0.7, 1.0, 1.2, 1.7 (IFOV)	0.2, 0.8, 13, 1.43, 0.94, 1.5 (Avg)	0.13, 0.6, 0.8, 0.94, 1.5 (Avg)	0.2, 1.1, 1.26, 0.94 1.5 (Avg)	0.8, 0.8, 0.8, 1.0 (Avg)
Size (m^3)	1	15	8	15	4
Weight (kg)	42	350	260	340	140
Power (W)	80	150	150	140	100
Data Rate (kbs)	2	100	100	35	12

PERFORMANCE GOALS*	Prec.	Acc'y	Res'n	Prec.	Acc'y	Res'n	Prec.	Acc'y	Res'n	Prec.	Acc'y	Res'n	Prec.	Acc'y	Res'n
Wind Speed	2 m/s	2 m/s	90 km	2 m/s	2 m/s	15	2 m/s	2 m/s	21	2 m/s	2 m/s	14	3 m/s	3 m/s	18
SST	1.0K	1.5K	150 km	0.5K	1.0K	35	0.5K	1.0K	35	0.5K	1.0K	35	N/A		
Ice Cover	**1%		27 km	1%		7	1%		7	1%		7	1%		14
Ice age	**1st yr/ multi yr	±10%	27 km	1st yr/ multi yr	±10%	3.5	1st yr/ multi yr	±10%	3.5	1st yr/ multi yr	±10%	3.5	1st yr/ multi yr	±10%	7
Atmos. Liquid Water	3 mg/cm^2		53 km	3 mg/cm^2		9	3 mg/cm^2		12	5 mg/cm^2		9	5 mg/cm^2		18
Atmos. Water Vapor	150 mg/cm^2		53 km	150 mg/cm^2		9	150 mg/cm^2		12	200 mg/cm^2		9	200 mg/cm^2		18
Precip. Over Land	**yes/no		27 km	yes/no		9	yes/no		9	yes/no		9	yes/no		18
Precip. Over Water	±1 octave		53 km	±1 octave		9	±1 octave		9	±1 octave		9	±1 octave		18
Soil Moisture	N/A			N/A			N/A			N/A			N/A		
Salinity	N/A			N/A			N/A			N/A			N/A		

* Performance goals are based on analytical models assuming calm sea surface and perfectly calibrated radiometer and antenna systems.
** Theoretically attainable precision - no current plans for implementation.

Reference: Green Book

Table 3. 4 M Aperture LAMMR

Frequency, GHz	4.3	10.65	18.7	21.0	36.5	91.0
Beamwidth, Deg.	1.22	0.49	0.28	0.25	0.25	0.25 (0.13)
Surface Resolution, Km	22x34 (29x45)	9x14 (12x18)	5x7.8 (6.7x10.4)	4.5x7 (5.9x9.3)	4.5x7 (4.5x7)	4.5x7 (2.2x3.5)
Integration Time, ms	7.7 (10.2)	3.1 (4.1)	1.8 (2.4)	1.6 (2.1)	1.6 (1.6)	1.6 (0.8) 2 beam
System Noise Temp., °K	400	500	400	400	800	1200
Predetection Bandwidth, MHz	200	100	100	100	700	1000
Sensitivity, °K	0.167	0.86	1.3 (1.1)	1.43 (1.26)	0.94 (0.94)	0.94 (1.53)

NOTES:

1. T_A = 200°K at all channels except 4.3 where T_A = 150°K
2. Values in ( ) are for a 45° view angle, 3 meter aperture, 1400 km swath, and 2 beam 91 GHz system.
3. Surface resolution defined by the footprint of the 3 dB antenna beamwidth.
4. Integration time is defined as the time required for one antenna beam to scan crosstrack the dimension of the major axis of the elliptical 3 dB footprint.
5. Assume total power radiometers.
6. System scan rate must be set to provide contiguous 3 dB maps at all channels in the in-track dimension.
7. Sensitivity in °K = $\Delta T_{RMS} = \dfrac{T_A + T_S}{(B_W x \tau)^{1/2}}$

τ = integration time from note 4
B_W = predection bandwidth in Table 3
T_S = system noise temperature
T_A = antenna noise temperature

TABLE 4
LAMMR INTERFACE REQUIREMENTS

PURPOSE: Measurement of sea surface temperature and wind speed, sea ice concentration, and type.

TECHNIQUE: Multichannel microwave radiometers measure brightness temperatures which are proportional to the geophysical measurements.

STATEMENT OF DEVELOPMENT: Phase A conceptual design study completed November 1978. Phase B design study (6 month) started August 1979. Breadboard development scheduled in FY 80.

DESCRIPTION: 3.6 meter offset parabolic reflector conically scanned 360° at 1 RPS. Radiometer channels 4.3, 10.65, 18.7, 21.3, 36.5. V&H polarization for each channel. Beamwidths 1.3 to 0.26°.

MAX. ENVELOPE AND WEIGHT: $140m^3$ scanned volume (Figure 3*). 320 Kgm.

FIELDS OF VIEW:
- SENSING: 120 to 180° forward: (Figure 4) 43° nadir cone angle; 1.3 to 0.26 beam.
- CALIBRATION/COOLING: Hot load/cold sky horn calibration; 20° FOV cold space, minimize sun views.

ELECTRICAL:
- POWER: +28 ± .3 Vdc, 285 watts maximum +24 to +32.5 Vdc unreg. 65 watts.
- COMMAND: 30 relay coil (125 ohm to 15 Kohm) (+20 to +32 volt pulse). Data commands (20 Kohm ± 6 Kohm) (+4.5 ± 1.0V pulse).
- TELEMETRY: 35 analog (0 to 5.12V); 100 digital (Logic "0" = 0.2 ± 0.2 Vdc: Logic "1" = 1.8 to 5.5 Vdc).
- DATA: 60 Kbps maximum.
- CLOCK: TBD

MECHANICAL/THERMAL:
- TEMPERATURE: Electronics -10°C to 40°C; steady state reflector/structure: -50°C to +100°C.
- MOMENTUM: Uncompensated <1.0 ft.lb.-sec. Torque disturbance (except during startup transient), see Figure 5. Startup transient: net momentum imparted to the spacecraft shall be less than 5 ft.lb.-sec. during startup and controlled shut down.
- DISSIPATION: 350 watts
- ALIGNMENT: TBD
- MAGNETIC MOMENT: TBD
- POINTING ACCURACY: 0.03° knowledge of position.

SPECIAL REQUIREMENTS: Pyrotechnics for scan mechanism release may be required.

*Reference: Appendix E of NASA GSFC RFP No. 5-19625/301 dated October 3, 1979 for NOSS

TABLE 5

EMITTER GEOGRAPHICAL DISTRIBUTION SUMMARY

	WORLD	1	2	3	TOTAL FOR REGIONS
3.0 -7	108,686	14,728	77,283	16,679	108,690
10.5-11.0	14,044	168	13,601	255	14,024
13.4-14.0	577	23	320	217	560
14.5-14.7	69	4	50	11	65
17.0-18.8	77	9	36	27	72
20.8-22.4	21	7	10	5	22
34.0-35.5	72	3	45	27	75
36.0-37.0	52	4	21	30	55
76.0-77.0	0	0	1	0	1
88.0-92.0	1	0	0	0	0

APPENDIX A

NOSS FREQUENCY ALLOCATION COMMENTS

NAVAL RESEARCH LABORATORY

WASHINGTON, D.C. 20375

IN REPLY REFER TO:
7006-62:CDC:mat
12 October 1978

To: Sensor Group
From: C. David Crandall, Code 7006C

Subj: NOSS Frequency Allocation Comments

Encl: (1) Frequency Allocation Table
(2) Frequency Allocation Status Report

1. The NOSS Sensor Working Group has identified the following frequencies as having potential usage on the NOSS satellite.

f(GHz)	Sensor
1.2 - 1.3	SAR
4.2 - 4.8	SMMR
6.4 - 6.8	SMMR
10.5 - 11.0	SMMR
13.4 - 14.0	SRA
14.5 - 14.7	SCAT
17.0 - 18.6	SMMR
20.8 - 22.0	SMMR
36.0 - 38.0	SMMR
90.0 - 95.0	SMMR

2. Enclosure (1)(Part 1) contains excerpts from the tables of Frequency Allocations and other extracts from the Manual of Regulations and Procedures for Radio Frequency Management, January 1978 Edition. Enclosure (1) (Part 2) contains excerpts from the FCC's Eighth Notice of Inquiry (NOI) released 5 May 1978. The NOI represents the proposed United States position on frequency allocation matters.

3. Enclosure (2) reports a telecon with Mr. William Shaffer of NASA. The status report contains the results of decisions and compromises, and, as a result, the frequencies may not agree with those above.

4. Considerable work has been done and is being done regarding frequency allocation for space sensors through IRAC (Interdepartment Radio Advisory Committee). If other frequencies are identified as being of interest, Agency IRAC representatives should be made aware of them.

C. David Crandall

APPENDIX A

Part I

EXCERPTS FROM THE MANUAL OF REGULATIONS AND PROCEDURES FOR RADIO FREQUENCY MANAGEMENT

Section 1

Enclosure (1) (Part 1) to
NRL Memo 7006-62:CDC:mat
12 October 1978

NOTES ON USAGE

The following pages are a faithful reproduction of selected portions of the "Manual of Regulations and Procedures for Radio Frequency Management". The tables are in two parts, International and United States. The international portion of these tables is part of ITU Table of Frequency Allocations as contained in Article 5 of the International Telecommunications Union (ITU) Radio Regulations, 1968 Edition, as revised by the World Administrative Radio Conferences (WARC), Geneva.

The United States portion of this part of enclosure (1) is taken from the National Table of Frequency Allocations which is comprised of the U.S. Government Table of Frequency Allocations and the FCC Table of Frequency Allocations. The United States Table indicates the normal national frequency allocation planning and the degree of conformity with the ITU Table. All United States changes through January 1978 are included. To use these tables, look first along the left-hand column for the frequency of interest, then read to right for the allocated usage. Of particular note are the Footnote numbers. All referenced footnotes have been copied and follow tables.

INTERNATIONAL			UNITED STATES				
Region 1 MHz	Region 2 MHz	Region 3 MHz	Band MHz 1	National Provisions 2	Government Allocation 3	Non-Government Allocation 4	Remarks 5
1215-1300	RADIOLOCATION Amateur 342 343 344 345		1215-1300	G, NG US34	RADIOLOCATION	Amateur	
3600-4200 FIXED FIXED-SATELLITE (Space-to-Earth) Mobile 374	3700-4200 FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE 379		3700-4200	NG		FIXED FIXED-SATELLITE (Space-to-Earth) NG41	Domestic public
4200-4400	AERONAUTICAL RADIONAVIGATION 352A 379A 381 382 383		4200-4400	G, NG US47	AERONAUTICAL RADIONAVIGATION G58	AERONAUTICAL RADIONAVIGATION	
4400-4700	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE		4400-4990	G US203	FIXED MOBILE		Unprotected radio astronomy observations are being carried out in the band 4950-4990 MHz. Users should, where possible, bear in mind the needs of the radio astronomy service in their future planning for the use of this part of the band.
4700-4990	FIXED MOBILE 233B 354 382A 382B						
6425-7250	FIXED MOBILE		6425-6575	NG		MOBILE	
			6575-6625	NG		FIXED NG8	
			6625-6875	NG		FIXED FIXED-SATELLITE (Space-to-Earth) NG8 NG103	
			6875-7125	NG		FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE NG11 NG103	
GHz	379A 392AA 392B 393		7125-7250	G 392B	FIXED MOBILE		
10.5-10.55 FIXED MOBILE Radiolocation	10.5-10.55 RADIOLOCATION 404		10.5-10.55 GHz	G,NG US59	RADIOLOCATION	RADIOLOCATION	
10.55-10.6	FIXED MOBILE Radiolocation		10.55-10.68	NG		MOBILE	
10.6-10.68	FIXED MOBILE RADIO ASTRONOMY Radiolocation 404A						

INTERNATIONAL			UNITED STATES				
Region 1 GHz	Region 2 GHz	Region 3 GHz	Band GHz 1	National Provisions 2	Government Allocations 3	Non-Government Allocation 4	Remarks 5
10.68-10.7	RADIO ASTRONOMY 405B		10.68-10.7	G, NG US74 US100	RADIO ASTRONOMY G45	RADIO ASTRONOMY	
10.7-10.95	FIXED MOBILE		10.7-10.95	NG		FIXED NG41	
10.95-11.2 FIXED FIXED-SATELLITE (Space-to-Earth) (Earth-to-Space) MOBILE	10.95-11.2 FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE		10.95-11.2	NG		FIXED FIXED-SATELLITE (Space-to-Earth) NG41 NG104	Non-Government Fixed-Satellite limited to international operations.
13.4-14	RADIOLOCATION 407 407A 408 409		13.4-14.0	G, NG US110	RADIOLOCATION Space Research (Earth-to-Space) G59	RADIOLOCATION Space Research (Earth-to-Space)	See Part 7.18 of Manual of Regulations and Procedures.
14-14.3	FIXED-SATELLITE (Earth-to-Space) RADIONAVIGATION 408A 407 407A		14.0-14.2	G, NG US207	RADIONAVIGATION Space Research (Earth-to-Space)	FIXED-SATELLITE (Earth-to-Space) RADIONAVIGATION Space Research (Earth-to-Space)	
			14.2-14.3	G, NG US207	RADIONAVIGATION	FIXED SATELLITE (Earth-to-Space) RADIONAVIGATION	
14.3-14.4	FIXED-SATELLITE (Earth-to-Space RADIONAVIGATION-SATELLITE 408A		14.3-14.4	G, NG US206 US207	RADIONAVIGATION-SATELLITE	FIXED-SATELLITE (Earth-to-Space) RADIONAVIGATION-SATELLITE	
14.4-14.5	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE 408B 408C		14.4-14.5	G, NG US203 US207	FIXED MOBILE Space Research (Space-to-Earth)	FIXED-SATELLITE (Earth-to-Space) Space Research (Space-to-Earth)	
14.5-15.35	FIXED MOBILE 408B 408C		14.5-15.35	G US203 *US211	FIXED MOBILE Space Research (Space-to-Earth)		
15.35-15.4	RADIO ASTRONOMY 409C		15.35-15.4	G, NG US74 US100	RADIO ASTRONOMY G45	RADIO ASTRONOMY	
15.7-17.7	RADIOLOCATION 407 408		15.7-17.7	G, NG US110	RADIOLOCATION G59	Radiolocation	See Part 7.18 of Manual of Regulations and Procedures
17.7-19.7	FIXED FIXED SATELLITE (Space-to-Earth) MOBILE		17.7-19.7	NG		FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE NG106	

INTERNATIONAL			UNITED STATES				
Region 1 GHz	Region 2 GHz	Region 3 GHz	Band GHz 1	National Provisions 2	Government Allocation 3	Non-Government Allocation 4	Remarks 5
19.7-21.2	FIXED-SATELLITE (Space-to-Earth) 409E		19.7-20.2	NG		FIXED-SATELLITE (Space-to-Earth)	
			20.2-21.2	G	FIXED-SATELLITE (Space-to-Earth) G107		
21.2-22	EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED MOBILE		21.2-22	G, NG	EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED MOBILE	EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED MOBILE NG107	
36-40	FIXED MOBILE 391A 412E		36.0-38.6	G US100	FIXED MOBILE		
			38.6-40.0	NG		FIXED MOBILE	
86-92	RADIO ASTRONOMY SPACE RESEARCH (Passive) 412J		86.92	G, NG 412J US74	RADIO ASTRONOMY SPACE RESEARCH (Passive) G45	RADIO ASTRONOMY SPACE RESEARCH (Passive)	
92-95	FIXED-SATELLITE (Earth-to-Space)		92-93	G, NG	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE G107	FIXED MOBILE	
			93-95	G, NG	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE	

FOOTNOTES

Government (G) Footnotes

(These footnotes, each consisting of the letter "G" followed by one or more digits, denote stipulations applicable only to the Government.)

G12 The allocation for the band 1215-1300 MHz does not of itself necessarily preclude Government aeronautical radionavigation operations in this band in certain specific cases where necessary and where fully coordinated.

G45 No stations will be authorized to transmit in the band 21850-21870 kHz, 1400-1427 MHz, 2690-2700 MHz, 4990-5000 MHz, 10.68-10.70 GHz, 15.35-15.40 GHz, 23.6-24.0 GHz, 31.2-31.5 GHz, 52.54.25 GHz, 58.2-59.0 GHz, 64-65 GHz, 86-92 GHz, 101-102 GHz, 130-140 GHz, 182-185 GHz and 230-240 GHz.

G55 Authority to operate a joint-use radar (Air Defense/Air Traffic Control) in the band 216-225, 420-450, 1215-1300 and 2300-2500 MHz may be issued to the agency responsible for the technical operation and maintenance of that radar. Despite this dual usage, such radars shall be authorized in the radiolocation service. Present and future requirements for air defense needs shall take precedence over any secondary usage for air traffic control purposes.

G56 Government radiolocation in the bands 1215-1300, 2900-3100, 5350-5650 and 9300-9500 MHz is primarily for the military services; however, limited secondary use is permitted by other Government agencies in support of experimentation and research programs. In addition, limited secondary use is permitted for survey operations in the band 2900-3100 MHz.

G58 No stations will be authorized to transmit in the band 4200-4400 MHz except altimeter stations and experimental stations. Experimental stations will not be authorized to develop equipment for operational use in this band other than equipment related to altimeter stations.

G59 In the bands 902-928 MHz, 3100-3300 MHz, 3500-3700 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz and 24.05-24.25 GHz, all Government non-military radiolocation shall be secondary to military radiolocation, except in the sub-band 15.7-16.2 GHz airport surface detection equipment (ASDE) is permitted on a coequal basis subject to coordination with the military departments.

G107 Military earth stations in the band 7250-7750 and 7900-8400 MHz and 20.2-21.2, 30-31, 92-93, 102-103, 140-141 and 150-151 GHz may be fixed, transportable or located on board a ship or aircraft.

G111 In the band 1215-1250 MHz, the frequency 1227.6 MHz with emissions limited to $\pm$12 MHz bandwidth, is also allocated to the Radionavigation Satellite Service, for satellite down link transmissions only. The power flux density at the earth's surface from such transmissions shall not exceed $-152 dBW/m^2/4kHz$. The Radionavigation Satellite Service shall not cause harmful interference to the Amateur Service and shall accept any harmful interference that may be caused by the Amateur Service.

US Footnotes

(These footnotes, each consisting of the letters US followed by one or more digits, denote stipulations applicable to both Government and non-Government stations.)

US34 The only non-Government service permitted in the bands 220-225 MHz, 1215-1300 MHz, 2300-2450 MHz and 5650-5925 MHz is the amateur service. The amateur service shall not cause harmful interference to the radiolocation service.

US47 The band 4200-4400 MHz is reserved exclusively for radio altimeters.

US74 In the bands 21.85-21.87, 73-74.6, 406.1-410, 1400-1427, 1660-1670, 2690-2700, and 4990-5000 MHz and in the bands 10.68-10.7, 15.35-15.4, 23.6-24, 31.2-31.5, 86-92, 130-140 and 230-240 GHz, the radio astronomy service shall be protected from extra-band radiation only to the extent that such radiation exceeds the level which would be present if the offending station were operating in compliance with the technical standards or criteria applicable to the service in which it operates.

US100 In the Additional Protocol to the Final Acts of the Space EARC, Geneva, 1963, a declaration on behalf of the USA states that the USA cannot accept any obligation to observe the exception claimed by Cuba in those footnotes to the Table of Frequency Allocations which were adopted by the EARC and which specifically named Cuba.

US110 In the frequency bands 3100-3300 MHz, 3500-3700 MHz, 5250-5350 MHz, 8500-9000 MHz, 9200-9300 MHz, 9500-10000 MHz, 13.4-14.0 GHz, 15.7-17.7 GHz, 24.05-24.25 GHz and 33.4-36 GHz, the non-Government radiolocation service shall be secondary to the Government radiolocation service and to airborne doppler radars at 8800 MHz, and shall provide protection to airborne surface detection equipment (ASDE) operating between 15.7-16.2 GHz.

US203 Government and non-Government radio astronomy observations of the formaldehyde line frequencies 4825-4835 MHz and 14.485-14.515 GHz may be made at certain Radio Astronomy Observatories as indicated below:

Bands to be Observed

4 GHz	14 GHz	Observatory
X	X	National Radio Astronomy Observatory Green Bank, W. Va.
X	X	Tucson (Kitt Peak), Ariz.
X	X	Naval Research Laboratory Maryland Point, Md.
X	X	Hat Creek Observatory (U of Calif.) Hat Creek, California

(US Footnotes Continued)

4GHz	14 GHz	Observatory
X	X	Haystack Facility (MIT-Lincoln Lab) Tyngsboro, Mass.
X		Agassiz Station (Harvard College) Harvard, Mass.
X	X	Owens Valley Radio Observatory (Cal. Tech.) Owens Valley, California
X		University of Michigan Dexter, Michigan
X		Harvard Observatory Ft Davis, Texas
	X	University of Texas Ft Davis, Texas
	X	Aerospace Corp. El Segundo, California (to be moved to Owens Valley)

Every practicable effort will be made to avoid the assignment of frequencies to stations in the fixed or mobile services in these bands. Should such assignments result in harmful interference to these observations, the situation will be remedied to the extent practicable.

US206 The use of the band 14.3-14.4 GHz by the radionavigation satellite service shall be such as to provide adequate protection to space stations of the fixed satellite service.

US207 In the band 14.0-14.5 GHz, only non-Government operations will be authorized in the fixed-satellite service.

*US211 In the bands 1427-1429, 2500-2690 and 5000-5250 MHz and 14.5-15.35, 15.4-15.7, 24-24.05, 31.5-31.8, 84-86, 122.5-130 and 220-230 GHz, applicants for space station assignments are urged to take all practicable steps to protect observations in the adjacent exclusive radio astronomy bands from harmful interference; however, US74 applies.

*FCC action pending 5/22/73.

International Footnotes

(These footnotes come from the Radio Regulations, Geneva 1959, the Final Acts of the Space EARC, Geneva, 1963, the Final Acts of the Maritime Mobile WARC, Geneva, 1967, or the Final Acts of the Space WARC, Geneva, 1971.)

342 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the band 1 215-1 300 MHz is also allocated to the fixed service.

343 In Belgium, France, Norway, the Netherlands, Portugal and Sweden, the band 1 215-1 300 MHz is also allocated to the radionavigation service.

344 In China, India, Indonesia, Japan, Pakistan, Portuguese Oversea Provinces in Region 1 south of the equator, and in Switzerland, the band 1 215-1 300 MHz is also allocated to the fixed and mobile services.

345 In the F.R. of Germany, the band 1 250-1 300 MHz is allocated to the amateur service.

352A The bands 1 558.5-1 636.5 MHz, 4 200-4 400 MHz, 5 000-5 250 MHz and 15.4-15.7 GHz are reserved on a world-wide basis for the use and development of airborne electronic aids to air navigation and any directly associated ground-based or satellite-borne facilities.

354 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 1 660-1 690 MHz, 3 165-3 195 MHz, 4 800-4 810 MHz, 5 800-5 815 MHz and 8 680-8 700 MHz are also used for radio astronomy observations.

374 In the United Kingdom, the band 3 400-3 770 MHz is allocated to the radiolocation service.

379 In Australia, the band 3 700-3 770 MHz is allocated to the radiolocation and fixed-satellite services.

379A The standard frequency-satellite service and the time signal-satellite service may be authorized to use the frequency 4 202 MHz for space-to-Earth transmissions and the frequency 6 427 MHz for Earth-to-space transmissions. Such transmissions shall be confined within the limits of $\pm$ 2 MHz of these frequencies and shall be subject to agreement between the administrations concerned and those having services operating in accordance with the Table, which may be affected.

381 In China and the Philippines, the band 4 200-4 400 MHz is also allocated, on a secondary basis, to the fixed service.

382A Radio astonomy observations on the formaldehyde line (rest frequency 4 829.649 MHz) are being carried out in a number of countries under national arrangements. Administrations should bear in mind the needs of the radio astronomy service in their future planning of the band 4 825-4 835 MHz.

(International Footnotes Continued)

382B Radio astronomy observations in the band 4 950-4 990 MHz are being carried out in a number of countries under national arrangements. Adminstrations should bear in mind the needs of the radio astronomy service in their future planning of this band.

383 In Austria, Denmark, Norway, the F.R. of Germany, Sweden and Switzerland, the band 4 200-4 210 MHz is also allocated, on a secondary basis, to the fixed service.

391A Radio astronomy observations are being carried out in the band 5 750-5 770 MHz and 36.458-36.488 GHz in a number of countries under national arrangements. Administrations are urged to take all practicable steps to protect radio astronomy observations in these bands from harmful interference.

392AA In Brazil, Canada and the United States of America, the band 6 625-7 125 MHz is also allocated on a secondary basis to the fixed-satellite service for space-to-Earth transmissions. In Region 2, the power flux density produced by space stations in this band shall be in accordance with the provisions of No. 470NM. In Regions 1 and 3, it shall be at least 6 dB lower. Receiving earth stations in this band may not impose restrictions on the locations or technical parameters of existing or future terrestrial stations of other countries.

392B The band 7 145-7 235 MHz may be used for Earth-to-space transmissions in the space research service, subject to agreement between the administrations concerned and those having services operating in accordance with the Table, which may be affected.

393 In Italy, the band 6 450-6 575 MHz is also allocated to the radio-location service.

404 Limited to continuous wave systems.

404A In the F.R. of Germany, in the band 10.6-10.68 GHz, the radio astronomy service is a secondary service.

405B In Algeria, Bulgaria, Cuba, Hungary, Japan, Kuwait, Lebanon, Pakistan, Poland, the United Arab Republic, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 10.68-10.7 GHz is also allocated to the fixed and mobile services.

407 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia and the U.S.S.R., the bands 13.25-13.5 GHz, 14.175-14.3 GHz, 15.4-17.7 GHz, 23.6-24 GHz, 24.05-24.25 GHz and 33.4-36 GHz are also allocated to the fixed and mobile services.

(International Footnotes Continued)

407A The band 13.25-14.2 GHz may also be used on a secondary basis for Earth-to-space transmissions in the space research service, subject to agreement between the administrations concerned and those having services operating in accordance with the Table, which may be affected.

408 In Sweden, the bands 13.4-14 GHz, 15.7-17.7 GHz and 33.4-36 GHz are also allocated to the fixed and mobile services.

408A The use of the bands 14-14.3 GHz, and 14.3-14.4 GHz by the radionavigation service and radionavigation-satellite service respectively, shall be such as to provide sufficient protection to space stations of the fixed-satellite service (see Recommendation No. Spa 2-15, Para. 2.14).

408B The band 14.4 -15.35 GHz may also be used on a secondary basis for space-to-Earth transmissions in the space research service, subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected.

408C Radio astronomy observations on the formaldehyde line (rest frequency 14.489 GHz) are being carried out in a number of countries under national arrangements. In making assignments to stations in the fixed and mobile services, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference in the band 14.485-14.515 GHz.

409 In Albania, Bulgaria, Hungary, Poland, Roumania, Czechoslovakia, and the U.S.S.R., the band 13.5-14 GHz is also allocated to the radionavigation service.

409C In Algeria, Bulgaria, Cuba, Hungary, Kuwait, Lebanon, Morocco, Pakistan, Poland, the United Arab Republic, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 15.35-15.4 GHz is also allocated to the fixed and mobile services.

409E In Japan, the bands 19.7-21.2 GHz and 29.5-31 GHz are also allocated to the fixed and mobile services. This additional use shall not impose any limitation on the power flux density of space stations in the fixed-satellite service.

412E In Bulgaria, Cuba, Hungary, Poland, Yugoslavia, Roumania, Czechoslovakia and the U.S.S.R., the band 36.5-37.5 GHz is also allocated to the radio astronomy service.

Non-Government (NG)
Footnotes

NG8 Frequencies in this band will be selected for assignment in such a manner that, on an engineering basis, the lowest frequency in the band is assigned which will not cause harmful interference to stations in that area already assigned frequencies in accordance with the Table of Frequency Allocation.

NG11 Television inter-city relay stations may be authorized to use frequencies in this band on the condition that harmful interference will not be caused to stations operating in accordance with the Table of Frequency Allocations.

NG41 Frequencies in the bands 3700-4200 MHz, 5925-6425 MHz, and 10.7-11.7 GHz may also be assigned to stations in the international fixed public and international control services located in U.S. Possessions in the Caribbean area.

NG103 In the band 6625-7125 MHz, the fixed-satellite service (space-to-earth) has equal rights with the fixed and mobile services within the United States. Internationally, however, it is secondary with respect to the services of other countries operating in accordance with the table and receiving earth stations in this band may not impose restrictions on the locations or technical parameters of existing or future terrestrial stations of other countries.

NG104 The use of the bands 10.95-11.2 and 11.45-11.7 GHz in the fixed-satellite service is limited to international systems, i.e., other than domestic systems.

NG106 In the band 18.36-19.04 GHz, frequencies in the band segments 18.36-18.58 GHz and 18.82-19.04 GHz may be assigned for use by operational fixed stations, only on condition that suitable alternative frequencies in the band segment 18.58-18.82 GHz are not available for assignment to such stations.

NG107 In the band 21.2-23.6 GHz, frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz may be assigned to domestic fixed public stations only on condition that suitable alternative frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz are not available for assignment to such stations. Similarly, frequencies in the band segments 21.2-21.8 GHz and 22.4-23.0 GHz may be assigned to operational fixed stations, only on condition that suitable alternative frequencies in the band segments 21.8-22.4 GHz and 23.0-23.6 GHz are not available for assignment to such stations.

APPENDIX A

Part I

EXCERPTS FROM THE EIGHTH NOTICE OF INQUIRY FCC-78-265 69894 Released 5 May 1978

Section 2

Enclosure (1) (Part 2) to
NRL Memo 7006-62:CDC:mat
12 October 1978

NOTES ON USAGE

The following pages were extracted from the FCC's report, Eighth Notice of Inquiry, May 5, 1978. The Eighth Notice of Inquiry documents the commissions stand taken during the FCC action resulting from the Fifth Notice of Inquiry. (6&7 did not relate to frequency allocation). Therefore, the following pages are the United States position going into the 1979 WARC (World Administrative Radio Conference). The tables correspond to the tables in part (1) of this enclosure. Preceding the tables are the narrative comments of the FCC during action on the Fifth Notice of Inquiry. Also, note that proposed changes to footnotes are included.

WARC's take place every two to five years, so if the Eighth Notice of Inquiry does not satisfy your requirements, it is important to contact the appropriate IRAC (Interdependent Radio Advisory Committee) representative. They are:

NASA -	Mr. James B. McElroy	755-2480
	Mr. Harold Kimball (Alt)	755-2480
DoC -	Mr. James E. Ogle	377-5446
	Mr. Fred Sena (Alt)	377-5446
DoD -	Mr. Harry A. Feigleson	695-2710
Navy -	CAPT James A. Madigan (Alt)	238-2420
NTIA -	Mr. Sam Probst	724-3301

Regrettably, the closing date for comments on the 3d, 5th, & 8th Notice of Inquiry has passed and the resulting Report and Order will be published in December 1978. To get a copy of the Report and Order you must contact your IRAC representative listed above.

Spectrum Between 1215 MHz and 10.7 GHz

92. In the 5th Notice it was pointed out (paragraph 192) that new demands for spectrum utilization far exceeded availability, and that the case for exclusivity in many instances was no longer valid. Consequently, in order to establish criteria which would permit the mutual and cooperative use of various frequency bands, detailed information was requested relevant to operating procedures and requirements for those services expected to share common portions of the spectrum (paragraph 196).

93. Unfortunately, the responses to the Fifth Notice provided virtually no such information and many difficulties still remain to be satisfactorily resolved.

94. The band between 1215 MHz and 10.7 GHz, due to the particular propagation characteristics which pertain, and the development of an economically viable technology, has become the prime spectrum location for the world's high density point to point and satellite services, much of the supporting mobile service, and major radiolocation and radio determination operations.

95. Since the presentation of the Fifth Notice there has been a continuing effort by all parties concerned to resolve outstanding problems. This work still continues and is expected to continue until satisfactory compromises have been established.

Aeronautical and Maritime Mobile Satellite

96. In our Fifth Notice we addressed frequency allocation requirements for aeronautical and maritime mobile satellite systems.

97. With respect to satellite systems, we addressed separately the frequency allocations between land earth stations and satellite and between satellite and mobile earth stations, and discussed allocations for coordinated distress and safety operations of aeronautical and maritime mobile satellite services.

98. Aeronautical and Maritime Mobile Satellite Services Allocations between satellite and earth stations on land: We stated that Fixed-Satellite Service allocations will continue to be needed for maritime communications between satellite and land; but that it may, however, be desirable to consider other allocations for frequencies between stations on land and satellites to meet additional requirements for greater communications capacity. In this connection, we proposed footnote 367C for the bands 2900-3100 MHz and 5460-5600 MHz, noted sharing difficulties likely to be encountered with existing services, and requested comments as to whether the concept should be proposed for the band 5000 to 5250 MHz.

99. The Maritime Service Working Group (RTCM SC 69) and Comsat General preferred the use of Fixed-Satellite Service bands. For example, in its reply comments Comsat General stated that planning for a second generation maritime satellite system is now in progress and is based on continued use of the 4 and 6 GHz bands for transmission between satellites and earth stations on land.[8/] We agree that the preferred allocations should be at 4 and 6 GHz for relatively near-term requirements. Therefore, we are proposing the band 4180-4205 MHz in the space-to-earth direction and the band 5920-5945 MHz in the earth-to-space direction in the fixed satellite service for feeder links between land stations and space stations in the maritime mobile service. As to our proposed footnote 367C, comments from the aeronautical and maritime communities have confirmed sharing problems, therefore we are withdrawing the proposal.

100. With respect to the band 5000 to 5250 MHz, while the Maritime SWG supported the suggestion for inclusion of maritime services on the basis that there exists the possibility of a satellite which would provide both aeronautical and maritime services, the Aeronautical Service Working Group (RTCA SC 129) opposed it since ". . . it bears no relationship to frequencies allocated in the 1535-1660 MHz band to the Aviation and Marine services . . ."

101. Whether there is a relationship between the two bands is not relevant since the 5 GHz band was originally intended for use between land stations (Air Traffic Control Centers) via satellite used for aeronautical mobile (R) and/or radiodetermination purposes and the 1550 MHz band was intended primarily for use between satellites and aeronautical or maritime mobile stations.

102. The immediate needs of the maritime mobile satellite service would be satisfied at 4 and 6 GHz in proposed Footnote 378B, while the proposed modification to footnote 383B would allocate the band 5000-5250 MHz to the Fixed-Satellite service for use by the aeronautical services. Therefore the immediate needs of both services would be satisfied.

103. We also foresee, as a later generation concept which is economically attractive, a single satellite system that satisfies

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8/ In its report of 19 October 1977, the technical panel of the INMARSAT preparatory committee indicated a strong preference to use the 6/4 GHz bands to meet long term connection needs of the Maritime Mobile-Satellite Service. It also indicated that following the 1979 WARC the question of frequencies to be used between satellites and earth stations on land will have to be reviewed in light of decisions made by that conference.

both the maritime and aeronautical mobile satellite interests. As a result, we have identified a total of approximately 65 MHz of spectrum in the space-to-earth direction and approximately 55 MHz in the earth-to-space direction as a combined requirement of the land station to space station feeder links. This amount of spectrum is equal to the aeronautical and maritime mobile satellite spectrum proposed in the 1535-1558.5, 1595-1660, 1710-1720, and 1970-1990 MHz bands. However, as yet, we have not been able to identify frequency bands to satisfy this future requirement; consequently, we invite comments specifically to address this point.

104. Allocations between satellite and mobile earth stations: In our Fifth Notice we requested comments as to which portions of the band 1535-1660 MHz, if any, should be re-allocated for maritime mobile satellite use. Comments of the aeronautical community opposed any increase in maritime mobile satellite allocations in this band and supported maintaining the band as currently allocated on the basis that ". . . the Aviation service is planning for the year 2000 and beyond to meet a world-wide requirement for an operational system for an aeronautical communications and navigation satellite system . . . "[9/] The Maritime SWG and Comsat General requested re-allocation in order to provide more frequencies for maritime mobile satellite systems. In its report of 19 October 1977, the technical panel of the INMARSAT preparatory committee recommended an increase to 15 MHz (as compared to 7.5 MHz existing) in each direction of transmission between satellite and ships in addition to 5 MHz for uni-directional ship-to-shore high speed data transmission.

105. The United States has proposed that the Aerosat Council form a committee to determine the feasibility of an operational aeronautics satellite system for oceanic communications in lieu of AEROSAT. Hearings before the subcommittee on Communications of the House Interstate and Foreign Commerce Committee[10/] indicated that satellite aided navigation which provides for aircraft surveillance systems may not be needed at all, particularly if civil aviation is directly or indirectly to bear the costs; that the 1978 aeronautical conference would provide additional HF frequencies to provide for long range communications

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9/ The aeronautical community provided an update aviation requirements paper entitled: "A Study of Channel/Spectrum Requirements for an International Aeronautical Communications/Navigation Satellite System (1535-1660 MHz)" which states existing allocations may be insufficient.

10/ Hearing on Aeronautical Communications, October 4, 1977.

thus enabling use of existing equipment aboard aircraft;[11] and that the rising costs of international communications charges discourage proliferation of communications equipment operating in different frequency bands aboard aircraft. In testimony before the Subcommittee on Transportation, Aviation and Weather of the House Committee on Science and Technology,[12] the International Air Transport Association estimated the likely date for an operational aeronautical satellite system to be beyond 1995. Moreover, an International Civil Aviation Organizational report which includes air traffic forecasts states that the average annual air traffic growth rate over the next decade is expected to be lower than the ten year period of 1966-1977.[13]

106. On the other hand, however, the maritime community is progressing more rapidly toward an international system.

107. Although we are proposing the re-allocation shown in our table to provide for expanding the shared Aeronautical and Maritime Mobile satellite allocations by 6 MHz and reducing the exclusive Aeronautical Mobile-Satellite allocations to 9 MHz in each band for communication between aircraft and satellite, we would like more specifics on both aviation and maritime requirements. While this re-allocation would not meet the full exclusive request of either the maritime or aviation communities, we believe it offers the flexibility needed for future planning. Each mobile-satellite service would have sufficient exclusive allocations to meet initial needs. The shared frequency bands would be available for assignment on approved application by either service at some future time when the need is demonstrated and after prior operational coordination between the two services.

108. The potential conflicts of existing footnotes 352 and 352D with the services allocated in the band 1550-1660 MHz has been recognized and although the U.S. will not propose deletion of these footnotes, full protection and operational flexibility for the aeronautical and maritime services will be pursued.

109. Additionally, we have concluded that the exclusive allocations for the Aeronautical Mobile-Satellite Service should be used only for air-traffic control purposes. Therefore, we are proposing an appropriate footnote - 352M. We also propose to continue footnote 352L in order to provide for distress and safety communications.

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[11] However, in order to satisfy stated requirements, the AWARC-78 found it necessary to forecast requirements only to 1990 in order to accommodate them within the HF spectrum available to Aeronautical Mobile (R) Service.

[12] Hearings on FY-78 FAA Authorization, February 24, 1977.

[13] ICAO circular 133-AT/40 "A Review of the Economic Situation of Air Transport 1966-1977."

110. As for the high data rate applications for special ship-to-shore services, we believe that these should be satisfied in other frequency bands and so are continuing our proposals at 1710-1720 MHz and 1970-1990 MHz. Power flux density limits for sharing the 1710-1720 MHz are being developed.

Mobile Satellite

111. Urgent and important requirements for Government mobile-satellite communications have been stated for the bands 7250-7750 and 7900-8400 MHz for worldwide use. Allocations have been proposed for mobile-satellite operations in limited bands shared only with the fixed-satellite service and in wider bands to be shared with existing space and terrestrial services. In those portions shared with terrestrial services, airborne use would be prohibited to preclude possible interference to fixed and mobile services. However, accommodation of mobile satellite service sharing with fixed and mobile services is still under discussion.

Maritime Mobile

112. The maritime interests noted that the first frequency band currently available above 960 MHz which could be used to satisfy expanded communication requirements of the maritime mobile service is at 10.55-10.68 GHz. The types of communications for which additional spectrum is needed to enhance the protection of life, property and the environment includes both voice and record communications from ship to shore, shore to ship and ship to ship. They involve remote control of various vessel operational functions; record communications including radioteletypewriter, facsimile and data; future collision avoidance systems; tug-tow telemetry/telecommand systems and ship-shore interface communications for handling dangerous cargoes. Because this band is currently available and can be employed to satisfy much of this foreseen expansion, the maritime interests have requested that a footnote RR404C be made applicable to the 10.55-10.68 GHz band to assure that it is available in the future to meet these needs. Footnote RR404C would read:

RR404C Operations of the Maritime Mobile Service using this band for safety of ship movement by telemetry, data exchange and telecommand systems shall be protected from harmful interference in areas of inland waterways, ports and coastal zones.

113. A passive sensor requirement has also been identified in the 10.6-10.7 GHz band (see paragraph), for which sharing arrangements with other services in the band have not been resolved.

Radar Beacons and Shipboard Transponders

114. Comments on how to best accommodate radar beacons, which are used to identify selected navigational aids and off shore structures, and shipboard transponders, which offer collision avoidance capability, were divided between the aeronautical and maritime communities.

115. The maritime community requested that fixed frequency radar beacons (RACONs), as described in REC MAR 2-13, be accommodated in the 2900-2920 and 9300-9320 MHz bands while fixed frequency shipboard transponders, as described in REC MAR 2-14, be accommodated at 3090 MHz and 9490 MHz. Frequency separation to preclude the potential for interference is needed in view of the important potential for safety improvement offered by each system. Comments indicated that the spectrum between 9480 and 9500 MHz is relatively unused, thus the probability of interference to receivers operating in that band would be comparatively low; based on our information, we agree with the comments.

Broadcasting Auxiliary

126. The frequency band 6425-6925 MHz is proposed to satisfy the uplink requirements of the international Fixed-Satellite Service; the service would utilize a few earth stations located in places away from population centers. Currently, the frequency band 6875-6925 MHz is used by the Broadcast Auxiliary Service. The elevation angles of these earth stations are such that the interference to Broadcast Auxiliary Service could be caused from the sidelobes of the earth station antennas. However, it is not expected that the small number of earth stations would produce any practical limitations on the operation of the Broadcast Auxiliary Service.

127. Regarding comments received with respect to the 1990-2110 MHz band, the inclusion of the Earth Exploration Satellite and Space Research Services into this band would not substantially increase the number of users. Therefore, the current sharing arrangements would remain valid.

The use of ISM Frequencies and the Wireless Transmission of Power

128. An extensive discussion was presented on the wireless transmission of power in the Fifth Notice (paragraph 91-103). Since that time further studies have been made concerning such a service. Of concern is the possibility for harmful interference. If such problems should develop, the use of two frequencies would greatly aggravate the problem, and there does not seem to be much support for the use of a second frequency in developmental planning. By virtue of technology and propagation, 2450 MHz is the best frequency choice, and we therefore propose that only this frequency be used for the service. We are proposing to limit the power spectrum to $\pm$ 10 MHz, but there is some uncertainty as to the level of emission

136. Although we have not identified specific allocations for the Fixed-Satellite downlink in this order of spectrum, we are continuing our proposal for the 6425-6925 MHz band for the Fixed-Satellite Service in the earth-to-space direction. The problems associated with sharing between this proposed uplink and the Broadcast Auxiliary Service is discussed under the latter topic.

Space Radars

137. Radars are required for spacecraft docking, launch of spacecraft from shuttles, rendezvous, planetary landings, and in the future, interplanetary navigation. Frequency requirements have been identified in the bands 3.1-3.3, 5.25-5.35 and 9.5-9.8 GHz. The possibility of satisfying these requirements and the method for incorporating any allocations into the Radio Regulations remain under study.

Space Electronic Measuring Equipments

138. Frequency requirements for space equipments which electronically measure the earth's environment have been identified; they exist in the bands 1.215-1.30, 3.1-3.3, 5.25-5.35, and 9.5-9.8 MHz. The matter of satisfying these requirements remains under study.

Meteorological Satellite

139. In the Fifth Notice we proposed the exclusive worldwide allocation of the band 1700-1710 MHz to the Meteorological Satellite Service. While no objection was expressed to the insertion of the allocation for this service, considerable opposition was expressed during bilateral discussions with European administrations, to the deletion of the Fixed service from the band. In response to these objections, we are now proposing to retain the Fixed service in Region 1, but on a secondary basis. This proposal is based on our conviction that no interference would be experienced by the Fixed service in any event, and its accommodation on a secondary basis would avoid the difficulties of coordination that are required when services share equally. This conviction is based on the experience accumulated during years of operation in the band 1690-1700 MHz, where the Fixed service has been secondary without any instance of interference.

Spectrum Between 10.7 GHz and 40 GHz

Broadcasting Satellite

140. The subjects concerning the bands between 10.7 and 12.5 GHz and the provision of an uplink to feed the Broadcasting-Satellite service in the 12 GHz band are discussed below under the heading of Fixed-Satellite.

141. The Joint Council for Educational Television (JCET) stated that "The bands 41-43 GHz and 84-86 GHz are not considered likely to be usable for the BSS by the century's end". NASA has started work on the development of 100 watt and 200 watt space qualified traveling wave tubes for operation at 41-43 GHz and a 200 watt space qualif ed traveling wave tube operation at 84-86 GHz with a saturated gain of 44 dB $\pm$ 1 dB and 74 dB $\pm$ 1 dB for the 100 W and 200 W tubes, respectively. We expect, therefore, that at least the 41-43 GHz band will be usable before the century's end.

142. JCET re-evaluated the needs of the Broadcasting Satellite Service and reduced the "market estimates" to 596 community reception and 64 individual reception television channels. JCET and CPB proposed that the 19.7-21.2 GHz band be equally shared by the Broadcasting-Satellite Service and the Fixed-Satellite Service in order to satisfy all the requirements. It is difficult to determine how "hard" the "market estimates" actually are. A number of experiments have been conducted utilizing one Applications Technology Satellite-6 channel and one Communications Technology Satellite channel. The Federal Government funded the appropriate cost of the space segments of both these satellites; however, we are not aware of a decision by any other single entity to fund an operational broadcasting-satellite. Thus we see no operational broadcasting-satellite in sight in the near future and yet we are asked to project nearly 700 operating channels by the year 2000.

143. As a result of the experience which the United States gained from the 1977 Broadcasting-Satellite WARC, it does not seem advisable to have the frequency band 19.7 to 21.2 GHz shared by the Fixed-Satellite and the Broadcasting-Satellite Services. After considering all the factors, we have not accepted the proposal for the 19.7 to 21.2 GHz band. If really needed, the development of the 41-43 GHz band would probably be expedited to meet expanding requirements.

Broadcasting

144. The TV Broadcasting Service Working Group recommended the retention of the Broadcasting Service in the bands 11.7-12.2 GHz and 12.2-12.5 GHz "- - - for future experimentation and possible development

Radio Astronomy

150. The Aeronautical Service Working Group recommended deletion of the second sentence of the footnote 412II, and ARINC/ATA recommended deletion of the second sentence of the footnote 412L as they were proposed in the Fifth Notice because they questioned the practicability of prevention of harmful interference to radio astronomy observations from airborne and spaceborne transmitters. The enforcement of such footnotes is dependent on the decision and discretion of individual administrations; we are proposing footnotes 412IA and 412L which could provide appropriate protection to radio astronomy observations.

151. The National Academy of Sciences (NAS) continued to press for the expansion of the 15.35-15.4 GHz Radio Astronomy allocation to meet the 100 MHz bandwidth requirement of the Very Large Antenna Array of the National Radio Astronomy Observatory. Radio systems are planned or under development in the 14.5-15.35 GHz band; therefore, a primary Radio Astronomy allocation is not possible in this part of the spectrum. We are proposing to introduce the modified footnote 233B in order to provide protection.

Meteorological-Satellite

152. In the 18 GHz region, the Meteorological-Satellite Service requires 200 MHz of spectrum, not 800 MHz as proposed in the Fifth Notice, to handle higher resolution systems for reading out such parameters as cloud cover data, vertical temperature profiles, and high altitude wind speeds, and relaying data from environmental platforms. The frequency band 17.7-17.9 GHz is proposed to satisfy this requirement.

Space Research and Earth Exploration Satellite

153. The successful missions of the experimental Earth resources satellites, LANDSAT 1 and 2 have shown that satellite-borne remote sensing systems offer significant advantages over more conventional methods for acquiring Earth resources data. Thus, proposals have been made for including active and passive microwave sensing frequencies in the Table of Allocations.

154. For passive sensor requirements, unresolved problems remain in the 1.37-1.8 GHz, 10.6-10.7 GHz and 17.7-17.9 GHz bands. The proposal for passive sensing in the 19.7-19.9 GHz band has been withdrawn as a result of comments to the Fifth Notice.

155. The frequencies below 20 GHz that have been proposed for passive sensing are needed for measurements of the earth's surface and oceans, such as soil moisture, salinity, sea surface temperature, sea state, ice, snow and rain. A sufficient number of suitably spaced frequencies are needed to separate the signal contributions received by a passive sensor at each frequency due to each of the above parameters.

156. Since a number of parameters are measured at each frequency, a single parameter can be masked by the other signals at a given frequency. Because each parameter produces a frequency dependent response, a complex analysis of the received signal at several frequencies permits resolution of individual parameters.

157. There is a need to identify bands for passive sensing below 20 GHz. The bands identified should present the best sharing possibilities. Unless steps are taken to ensure compatibility, the full potential benefits of passive sensing may not be realized. The impact of the active services on remote sensing is still under investigation and further evaluation of this problem is taking place. Sharing criteria similar to those suggested in the Fifth N.O.I. for the 10.6-10.7 GHz and 17.7-17.9 GHz bands may be required.

158. AT&T opposed NASA's proposal to limit the e.i.r.p. of the Fixed or Mobile Service to 40 dBW in the 17.7 to 17.9 GHz portion of the band as this proposal would inhibit future " . . . improvements in capacity and performance". Although the 17.7-17.9 GHz band is the lower part of the 17.7-19.7 GHz band used by the terrestrial radio relay systems, " . . . the economics of manufacturing, engineering and maintaining radio relay transmitters requires that they be substantially uniform in design and operation . . ." over the entire band. NASA's proposal, according to AT&T, would effectively prevent future " . . . achievement anywhere in that band of the improvements in capacity and performance . . ." AT&T's proposal was to limit the e.i.r.p. level to + 55 dBW.

159. COMSAT opposed NASA's proposal to establish a power flux density limit (pfd) in each of the 17.7 to 17.9 GHz and 19.7 to 19.9 GHz bands. COMSAT submitted that these proposals would unduly restrict the development of the Fixed-Satellite Service and suggested deletion of these proposals.

160. In light of those comments, NASA has restated the sensor requirement as a need for a 200 MHz wide band lying anywhere between 16 and 19 GHz and has suggested the frequency band 18.6-18.8 GHz as it falls in the center of the Fixed Service channel plans (CCIR Doc. 9/369). The wideband channels would be unaffected by the adoption of the sharing criteria proposed in the Fifth Notice. The maximum power flux density for the Fixed Satellite Service would be modified to -101 dBW/m^2 for the 200 MHz. This increase could be accommodated by moving the originally planned water vapor measurement, which requires the highest sensitivity, to bands on the high side of the water vapor line.

161. NASA has stated a requirement for primary allocations for space research at 13.25-13.4, 13.4-14, 14-14.2, 14.4-14.5, 14.5-15.2, and 15.2-15.35 GHz, these to be shared with the existing primary services. The frequencies would be for long term use through the year 2000 for space research operations on a world wide basis. Primarily, the space research tracking and data relay system would operate in these bands. The requirement has not been included in the table of allocations at this time since discussions regarding the requirement are still underway.

Intersatellite

162. COMSAT requested a bandwidth of 1 GHz in each direction for the Intersatellite service, instead of 0.3 GHz as proposed in the Fifth Notice, and recommended several candidate bands including 24.25-25.25 GHz and 31.8-32.3 GHz which have been suggested by INTELSAT to member administrations. Although COMSAT proposes to use this mode of operation between two geostationary satellites serving a single ocean region, frequencies allocated to this service could be used between satellites serving different ocean regions. As such, it is necessary to consider the feasibility of sharing the frequency band(s) under consideration between this service and other terrestrial and space services. We do not favor the "safety of life" Radionavigation Service sharing frequency bands with other active services, and it may be difficult for the

located at places away from the population centers. Hughes Aircraft opposed this proposed restriction on the fixed-satellite use of this band.

167. Currently, a number of experiments are in progress, both in the U.S. and in Canada, in the 11.7-12.2 GHz band. The transmitting earth station antenna diameters vary from approximately 1.2m to 9m. There are about 6 non-Government and 5 NASA transmitting earth stations in use in the U.S. We do not envision restricting the number of transmitting earth stations that could be used for an operational Broadcasting-Satellite Service in this band. We envision limiting the receiving Fixed-Satellite earth stations in 10.7-11.7 GHz to a small number for international use so as to ensure reasonable geographic sharing with the terrestrial services. Use of this band as an uplink to Broadcasting-Satellites would then place similar, or perhaps even more stringent, limitations on the uplink earth stations to the Broadcasting-Satellites, perhaps limiting them to one or two in number, or restricting them to very remote areas. As a result, the use of the Broadcasting-Satellite Service in this country would be severely restricted, precluding its use for many of the purposes which we envision.

168. Western Union stated that sharing of the 14.0-14.5 GHz band between the Fixed-Satellite and the Broadcasting-Satellite Services would result in inefficient orbit-spectrum utilization, and recommended that the Broadcasting-Satellite Service be shifted out of the 14/12 GHz bands to the 20.9-21.4 GHz and 18.7-19.2 GHz bands. However, FCC Report RS76-04 shows that sharing between the Fixed-Satellite and the Broadcasting-Satellite Services would not necessarily result in inefficient orbit-spectrum utilization.

169. Section 4.3.1 of the CCIR Report 561 (Rev. 74) gives, as pointed out by Comsat, results on the co-channel interference potential from a fixed-satellite space station to an adjacent broadcasting-satellite space station. How would these results be modified, if any, when the practical space station antenna patterns of the satellites such as the Communications Technology Satellite and INTELSAT-V are taken into consideration? Information is solicited regarding the measured values of the sidelobe levels of the INTELSAT IVA and V shaped beam antennas, as well as those of the Communications Technology Satellite.

Spectrum Above 40 GHz

175. In order to preserve flexibility, we are generally opposed to exclusive allocations above 40 GHz. In particular, based on experience from lower frequency bands such as 6/4 GHz, we believe that sharing between the Fixed and the Fixed-Satellite Services is feasible in this part of the spectrum. However, we do not precisely know the separation distance between an earth station and a fixed station. If an analysis on this subject is presented, we shall consider it.

176. There is an imbalance, as has been pointed out by both COMSAT and COMSAT General, between the widths of the paired Space-to-Earth and Earth-to-Space bands above 40 GHz. In some cases the imbalance has occurred because of the contemplated use of different modulation techniques for uplinks and downlinks; in other cases, the satisfaction of other requirements, or the presence of current fixed-satellite allocations has resulted in the imbalance. We are still studying this matter; however, except in the 71 to 81 GHz region which we are realigning to meet national requirements, we are not modifying our fixed-satellite proposals above 40 GHz.

177. Western Union proposed additional and regularly spaced frequency bands above 40 GHz for use by the Fixed-Satellite Service. We believe that we are proposing ample spectrum above 40 GHz for the Fixed-Satellite Service; the frequency bands are not regularly spaced as a result of satisfying the requirements of other services. Consequently, we have not accepted the proposal of Western Union.

178. To prevent interference to the Radio Astronomy Service, the proposed directions of transmission in the frequency bands 71-74 GHz and 81-84 GHz have been changed as shown in the Table of Allocations.

179. Because of the uncertainties of the apportionment of maritime and aeronautical requirements, it appears premature to separate the frequency bands 190-195 GHz and 195-200 GHz for aeronautical and maritime services. We are proposing to return to our original posture, that is, combine the aeronautical and maritime requirements in the 190-200 GHz frequency band as has been done at the lower frequencies.

180. The WARC Advisory Committee for Amateur Radio proposed the use of 120 GHz by a Footnote and the use of frequencies above 300 GHz. We have modified the Table of Allocations to reflect these proposals.

181. The Executive Branch notes that it has received a requirement from the Radio Astronomy Service for the allocation of the band 261-272 GHz to the Radio Astronomy Service. There are a number of spectral lines of astrophysical interest which can be observed in this frequency band. This requirement is under consideration.

CONCLUSION

182. As we have previously indicated in this proceeding, all participants should keep in mind the importance of the 1979 WARC results. Based upon past experience, decisions reached at this conference can be expected to provide the basis for international radio regulation policy for most of the remainder of this century. It is of the utmost importance to develop U. S. proposals which effectively promote that combination of telecommunication uses which offers the maximum social and economic contribution to the national welfare and which also contains the flexibility necessary to accommodate important new applications of this dynamic technology as well as the unique requirements of our international partners in the ITU. It must be recognized that the proposals presented herein pertain to the international Radio Regulations and that the domestic implementation of such proposals will require extensive U.S. national consideration.

183. Comments bearing on the proposed revisions to the international Table of Frequency Allocations and any other matters relevant to preparation for the 1979 WARC are hereby sought from all interested United States individuals, parties, or groups of parties which may exist.

184. Pursuant to applicable procedures set forth in Section 1.415 of the Commission's Rules, interested persons may file comments on or before June 30, 1978, and reply comments on or before July 21, 1978. All relevant and timely comments and reply comments, along with any pertinent information which we may have available, will be considered. When commenting, the effort should be made to avoid repetition of previously submitted views and information; and it should be borne in mind that this effort is directed toward international allocations and not domestic issues.

185. Although Section 1.419 of the Commission's Rules required that an original and five copies of all statements, briefs or comments be filed in response to a Notice, our conference preparatory organization necessitates the filing of an original and nineteen copies. All responses received will be available for public inspection during regular business hours in the Commission's Public Reference Room at its Headquarters in Washington, D. C.

186. This Notice is issued pursuant to the authority set forth in Section 4 (i) of the Communications Act of 1934, as amended 47 USC 154 (i).

FEDERAL COMMUNICATIONS COMMISSION *

William J. Tricarico
Secretary

*See attached Concurring Statement of Commissioner James H. Quello.

MHz

Region 1	Region 2	Region 3
1215-1300 1240	RADIONAVIGATION SATELLITE (Space-to-Earth) RADIOLOCATION Amateur 342 343 344 345	
1240-1300	RADIOLOCATION Amateur 342 343 344 345 346A MOD 320A	
1300-1350	AERONAUTICAL RADIONAVIGATION MOD 346 Radiolocation 347 348 MOD 349A	

Reason: Spectrum in the 1250-1260 band can be shared on a secondary basis for amateur satellite research. Band 1215-1350 needed for continued and expanding use of radiolocation and aeronautical radionavigation services.

1350-1400 1370 FIXED MOBILE RADIOLOCATION 349 MOD 349A	1350-1400 1370 RADIOLOCATION 349 MOD 349A 346A

MHz

Region 1	Region 2	Region 3
3600-4200	3500-3700 FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE RADIOLOCATION 378A	3500-3700 FIXED-SATELLITE (Space-to-Earth) RADIOLOCATION Fixed Mobile 377 378
FIXED FIXED-SATELLITE (Space-to-Earth) Mobile 374 378B		
	3700-4200 FIXED FIXED-SATTELLITE (Space-to-Earth) MOBILE 379 378B	

Reason: Continued and expanding use of fixed and mobile services and satellite Space-to-Earth links.

ADD 378A In the USA the band 3500-3700 MHz is also allocated to the Aeronautical Radionavigation service.

Reason: Required for planned use for low-cost short-range radionavigation terminal radars.

ADD 378B The bands 4180-4205 MHz Space-to-Earth and 5920-5945 MHz Earth-to-Space are also allocated to the fixed-satellite service for connection between one or more earth stations at specified fixed points on the earth and satellites which are used in the maritime mobile-satellite service. Such use and development shall be subject to agreement and coordination between administrations. No protection will be provided from radio altimeters.

Reason: To provide for frequencies between land and satellite for the use of the maritime mobile-satellite service.

MHz

Region 1	Region 2	Region 3
4200 - 4400	AERONAUTICAL RADIONAVIGATION ~~352A~~ 379A 379B 381 382 383 378B	

ADD 379B The use of the band 4200-4400 MHz by the Aeronautical Radionavigation service is reserved exclusively for airborne radio altimeters. However, Earth Exploration Satellite (Passive) and Space Research (Passive) services are allocated on a permitted basis provided that no protection will be required from the radio altimeter.

NOC 379A

REASON: To provide for the EES and Space Research services and to restrict the Aeronautical Radionavigation Service for the exclusive use of airborne radio altimeters. Requirement for standard frequency satellite service is still valid.

4400 - 4700	FIXED ~~FIXED-SATELLITE (Earth-to-Space)~~ MOBILE	

REASON: To provide greater compatibility for the fixed and mobile services.

4700 - ~~4990~~ 4950	FIXED MOBILE ~~233B~~ 354 MOD 382A ~~382B~~ 364I	

MOD 382A Radio astronomy observations on the of important spectral lines due to formaldehyde ~~line at (rest frequency~~ frequencies of ~~4829.649~~ 4829.66 ~~MHz)~~, 14.489, 72.838, 140.839, 145.603, 150.498 GHz are being carried out in a number of countries under national arrangements. The bands being observed are 4825-4835 MHz, 14.473-14.50, 72.70-72.90, 140.6-141, 145.45-145.75, and 150.35-150.65 GHz. ~~Administrations should bear in mind the needs of the radio astronomy service in their future planning of the band 4825-4835 MHz.~~ Administrations are urged to take all practicable steps to protect these radio astronomy observations from harmful interference.

4950 - 4990	FIXED MOBILE Radio Astronomy MOD ~~233B 354 382A 382B~~	

SUP 382B

Reason: Consequential to allocation change.

MHz

Region 1	Region 2	Region 3
5850-5925 FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE 391 378B	5850-5925 Amateur RADIOLOCATION 391 378B	5850-5925 FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE Radiolocation 391 378B

5925-6425 FIXED
FIXED-SATELLITE (Earth-to-Space)
MOBILE
378B

REASON: Continued use of fixed, mobile and fixed satellite services.

6425-~~7250~~
6925 FIXED
MOBILE
FIXED-SATELLITE (Earth-to-Space)
379A ~~392AA~~ ~~392B~~ 393 393A

ADD 393A In the band 6.425-7.125 GHz, passive microwave sensor measurements are carried out over the Earth's oceans. Administrations should bear in mind the needs of the earth exploration satellite (passive) and space research (passive) services in their future planning of this band.

Region 1	Region 2	Region 3
7900-7975	FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE MOBILE-SATELLITE (Earth-to-Space)	
7975-8025	MOBILE-SATELLITE (Earth-to-Space FIXED-SATELLITE (Earth-to-Space) 392H	
8025-8175 FIXED MOBILE MOBILE-SATELLITE (Earth-to-Space) FIXED-SATELLITE (Earth-to-Space) EARTH EXPLORATION-SATELLITE (Space-to-Earth) Earth-Exploration Satellite (Space-to-Earth) 394B	8025-8175 EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-Space) MOBILE MOBILE-SATELLITE (Earth-to-Space) 392E	8025-8175 FIXED MOBILE MOBILE-SATELLITE (Earth-to-Space) FIXED-SATELLITE (Earth-to-Space) EARTH EXPLORATION-SATELLITE (Space-to-Earth) Earth-Exploration Satellite (Space-to-Earth)
8175-8215 FIXED FIXED-SATELLITE (Earth-to-Space) METEOROLOGICAL-SATELLITE (Earth-to-Space) MOBILE Earth-Exploration-Satellite (Space-to-Earth) EARTH EXPLORATION-SATELLITE (Space-to-Earth) MOBILE-SATELLITE (Earth-to-Space) 394B	8175-8215 EARTH EXPLORATION-SATELLITE (Space-to-Earth) FIXED FIXED-SATELLITE (Earth-to-Space) METEOROLOGICAL-SATELLITE (Earth-to-Space) MOBILE MOBILE-SATELLITE (Earth-to-Space) 392E	8175-8215 FIXED FIXED-SATELLITE (Earth-to-Space) METEOROLOGICAL-SATELLITE (Earth-to-Space) MOBILE Earth-Exploration-Satellite (Space-to-Earth) EARTH EXPLORATION-SATELLITE (Space-to-Earth) MOBILE-SATELLITE (Earth-to-Space)

GHz

Region 1	Region 2	Region 3
10.5 - 10.55 FIXED MOBILE Radiolocation	10.5 - 10.55 RADIOLOCATION 404	

REASON: Continued need for existing services.

NOC 404

REASON: Preserve system compatibility.

10.55 - 10.6

FIXED
MOBILE Except Aeronautical Mobile
Radiolocation

10.6 - 10.68

FIXED
MOBILE except aeronautical mobile
RADIO ASTRONOMY
Radiolocation
404A 404B

10.68 - 10.7

FIXED
MOBILE except aeronautical mobile
RADIO ASTRONOMY
~~405B~~ 404B

SUP 405B Consequential to allocation change.
ADD 404B All airborne emissions are excluded.

REASON: Radio astronomy can share the 10.6 - 10.7 continuum band as long as airborne transmissions are excluded from the mobile and radiolocation services. The bands above are otherwise needed for continued and expanding use of the fixed, mobile and radiolocation services.

10.7 - 10.95

MOBILE
FIXED
FIXED SATELLITE (Space-to-Earth)

REASON: This frequency band is currently in considerable use in the radio-relay service in the United States. The fixed-satellite allocation is needed on a world-wide basis.

GHz

Region 1	Region 2	Region 3
13.4 - 14	Earth Exploration-Satellite (Active Sensors) Standard Frequency Satellite (Earth-to-Space) RADIOLOCATION Space Research 407 ~~407A~~ 408 409	
14 - ~~14.3~~ 14.2	Space Research FIXED SATELLITE (Earth-to-Space) RADIONAVIGATION MOD 408A 407 ~~407A~~	
14.2 - 14.3	FIXED SATELLITE (Earth-to-Space) RADIONAVIGATION MOD 408A 407 ~~407A~~	

REASON: This frequency band is currently used for marine radar. This frequency band will be used for long-haul and international voice and data channel communications. The band 13.4-14 is required for radiolocation type active sensors.

MOD 408A Spa2 The use of the bands 14-14.3 GHz ~~and 14.3-14.4 GHz~~ by the radionavigation service ~~and radionavigation satellite service respectively~~, shall be such as to provide sufficient protection to space stations of the fixed-satellite service (see Recommendation No. Spa2 - 15, paragraph 2.14).

REASON: Consequential to allocation change.

14.3 - 14.4	FIXED-SATELLITE (Earth-to-Space) ~~RADIONAVIGATION-SATELLITE~~ ~~408A~~	
14.4 - 14.5	Space Research (Space to-Space) MOBILE FIXED FIXED-SATELLITE (Earth-to-Space) ~~408B~~, ~~408C~~ MOD 382A	

Reason: These bands will be used for the domestic and international voice and data channel communications. The bands 13.25-14.2 and 14.4-14.5 GHz will be used for space research.

ADD 408B

REASON: Consequential to allocation change.

ADD 408C

REASON: Consequential to modification of Footnote 382A.

GHz

Region 1	Region 2	Region 3
14.5 - 15.2	FIXED MOBILE Space Research ~~408B~~ ~~408C~~ MOD 382A	
15.2 - 15.35	FIXED MOBILE Space Research Earth Exploration-Satellite (Passive) ~~408B~~ ~~408C~~ 364I	
15.35 - 15.4	EARTH EXPLORATION-SATELLITE (PASSIVE) SPACE RESEARCH (PASSIVE) RADIO ASTRONOMY 409C	
15.4 - 15.7	AERONAUTICAL RADIONAVIGATION-SATELLITE AERONAUTICAL RADIONAVIGATION ~~352A~~ ~~352B~~ 407 408D	

REASON: Other passive services can share the band 15.35 - 15.40 GHz. The band 15.4 - 15.7 GHz is required for continued and expanded use for microwave landing system (MLS) and airborne weather radar.

15.7 - 16.6	RADIOLOCATION 407 408 409CA	

REASON: The frequency band is required for radiolocation.

16.6 - 17.1	SPACE RESEARCH (DEEP SPACE ONLY)(EARTH-TO-SPACE) RADIOLOCATION 407 408	

ADD 409CA In the U.S., the portion 15.7-16.2 GHz may be used also for Airport Surface Detection Equipment (ASDE).

ADD 408D - The band 15.4-15.7 GHz is also allocated to the fixed-satellite service and to the inter-satellite service for connection between one or more stations at specified fixed points on the earth and on satellites when these services are used in conjunction with the aeronautical radionavigation service and/or the fixed service where such fixed service is used for aeronautical fixed purposes. Such use and development shall be subject to agreement and coordination between the administrations concerned and those having services operating in accordance with the Table, which may be affected.

Reason: To provide additional satellite system flexibility.

GHz

Region 1	Region 2	Region 3
17.1 - 17.35	RADIOLOCATION 407 408	
17.35 - 17.7	EARTH EXPLORATION SATELLITE (ACTIVE SENSORS) SPACE RESEARCH (ACTIVE SENSORS) RADIOLOCATION 407 408	
REASON: Space services listed appear to be compatible with existing services		
17.7 -17.9	METEOROLOGICAL SATELLITE (Space-to-Earth) FIXED FIXED-SATELLITE (Space-to-Earth) MOBILE	
17.9-19.7	FIXED-SATELLITE (Space-to-Earth) FIXED MOBILE	
Reason: Required for future expansion of Meteorological Satellite Systems requiring higher resolution sensors and higher data rates.		

GHz

Region 1	* *	Region 2	* *,	Region 3
19.7 - 21.2 20.2		FIXED-SATELLITE (Space-to-Earth) 409E		
20.2 - 21.2		FIXED-SATELLITE (Space-to-Earth) MOBILE-SATELLITE (Space-to-Earth) Standard Frequency Satellite (Space-to-Earth) 409E		

Reason: Required for Mobile-Satellite sharing.

GHz

Region 1	Region 2	Region 3
21.2 - 21.4	SPACE RESEARCH (Passive) EARTH EXPLORATION-SATELLITE ~~(Space-to-Earth)~~ (Passive FIXED MOBILE	
21.4 - 22	FIXED MOBILE ~~EARTH-EXPLORATION-SATELLITE (Space-to-Earth)~~	

REASON: This band will be used for terrestrial radio relay and for land mobile experimental, developmental and research uses.

22 - ~~22.5~~ 22.21	FIXED MOBILE ~~410A~~	

REASON: This frequency band will be used for terrestrial radio relay and for land mobile experimental, developmental and research uses.

22.21 - 22.5	FIXED MOBILE (except aeronautical mobile) EARTH EXPLORATION-SATELLITE (Passive) SPACE RESEARCH (Passive) RADIO ASTRONOMY ~~410A~~	

REASON: This frequency band will be used for radio astronomy observations of the water vapor line (rest frequency 22.235 GHz) and for terrestrial radio relay service and for land mobile experimental, developmental and research uses.

SUP 410A

REASON: Consequential to allocation changes.

GHz

Region 1	Region 2	Region 3
34.2 - 35.2	RADIOLOCATION ~~Space Research~~ SPACE RESEARCH (ACTIVE SENSORS) METEOROLOGICAL AIDS EARTH EXPLORATION SATELLITE (ACTIVE SENSORS) 407 408 412 412C 412D	
REASON: Required for radiolocation type sensors and meteorological aids radar.		
35.2 - 36	RADIOLOCATION 407 408 412	
36 - ~~40~~ 37	FIXED MOBILE SPACE RESEARCH (PASSIVE) EARTH EXPLORATION SATELLITE (PASSIVE) 391A 412E	
37 - 40	FIXED MOBILE ~~391A~~ 412E	
40 - 41	FIXED-SATELLITE (Space-to-Earth) FIXED MOBILE MOBILE-SATELLITE (Space-to-Earth)	
REASON: This band will be used for terrestrial systems and shared with the mobile- and fixed-satellite services.		
41 - 43	BROADCASTING-SATELLITE FIXED MOBILE 412L	

GHz

Region 1	**	Region 2	**	Region 3
84-86		BROADCASTING-SATELLITE FIXED MOBILE		

Reason: This frequency band will be used for terrestrial services and for providing service to multi-destination low cost users.

86-92		EARTH EXPLORATION-SATELLITE (Passive) RADIO ASTRONOMY SPACE RESEARCH (Passive) MOD 412J		

Reason: This frequency band will be used for radio astronomy observations and for conducting passive research in space.

92-95		RADIOLOCATION FIXED-SATELLITE (Earth-to-Space) FIXED MOBILE 412N		

Reason: The frequency band will be used for terrestrial services and transmission of voice, data, television signals by satellites. Also required for Radiolocation.

ADD 412N Radio astronomy observations of important spectral lines due to diazenylium (HNN^+) at rest frequencies of 93.172, 93.174, and 93.176 GHz are being carried out in a number of countries under national arrangements. The band being observed is 93.12-93.22 GHz. Administrations are urged to take all practicable steps to protect these radio astronomy observations from harmful interference.

APPENDIX A

Part II

COMMENTS ON CURRENT STATUS AS OF 1 OCTOBER 1978

Enclosure (2)
NRL Memo 7006-62:CDC:mat
12 October 1978

Mr. William Shaffer, NASA, 755-2070, provided the following status report:

Active Frequencies -
U.S. Position

GHz	STATUS	CONTROL
1.24 - 1.3	Assigned	DoD
3.1 - 3.2	"	"
5.25 - 5.35	"	"
9.5 - 9.6	"	"
13.4 - 14.0	"	"
17.35 - 17.7	"	NASA
34.2 - 35.2	"	"
76.0 - 77.0	"	"

Passive Frequencies -
U.S. Position

GHz	STATUS
4.2 - 4.4	Assigned primary
6.425 - 7.125	Warning footnote only, not assigned
10.6 - 10.7	Requested
18.6 - 18.8	"
21.2 - 21.4	Assigned primary
36.0 - 37.0	"
86.0 - 92.0	"

Problem Area

On SEASAT -
Scatterometer 14.59927GHz $\pm$ 500KHz

Altimeter 13.49932GHz $\pm$ 160MHz
1 GHz separation required.

On NOSS -
Total available allocation is 13.4 - 14.0GHz. 1 GHz separation is not possible. 9.5 - 9.6GHz allocation does not provide adequate bandwidth for altimeter, same with 5.25 - 5.35GHz.

APPENDIX B

RFI AT SMMR

RFI AT SMMR

Let the total power radiated (in watts) within the reception passband of SMMR by an interferring transmitter be P_{TRX}. Then the power radiated in some direction (θ,ϕ) per unit solid angle is:

$$P_X(\theta,\phi) = \left(\frac{P_{TRX}}{4\pi\eta}\right)\bar{G}_X(\theta,\phi) \quad , \quad \bar{G}_X(\theta,\phi) = G_X(\theta,\phi)\begin{vmatrix}1\\X_Q\\X_U\\X_V\end{vmatrix}$$

and $X_Q^2+X_U^2+X_V^2 = 1$.

Here η is the radiation efficiency, usually very close to unity. If P_{TX} is the power supplied to the antenna; $\eta = P_{TRX}/P_{TX}$. $\bar{G}_X(\theta,\phi)$ is the gain of the antenna in direction (θ,ϕ) and X_Q, X_U and X_V are the stokes parameters in that direction. Let the SMMR antenna, at a distance R, from the interferring transmitter have an effective area $\bar{A}_S(-\theta,-\phi)$ in the direction of the transmitter. Then it subtends a solid angle $\Omega = A_S/R^2$ and the power received by SMMR is

$$P_S = P_X\Omega = \left(\frac{P_{TX}}{4\pi}\right)\left(\frac{\bar{G}_X\,\bar{A}_S}{2\ R^2}\right) .$$

Now $\bar{A}_S(\theta,\phi) = \left(\frac{\lambda^2}{4\pi}\right)\bar{G}_S(\theta,\phi) = \left(\frac{\lambda^2}{4\pi}\right)G_S(\theta,\phi)\,|1+S_Q+S_U+S_V|$

$$P_S = P_{TX}\left(\frac{\lambda}{4\pi R}\right)^2 G_X G_S(1+X_Q S_Q+X_U S_U+X_V S_V)/2 \quad .$$

The factor $(1+X_Q S_Q+X_U S_U+X_V S_V)/2 = \rho$ depends upon the polarization of the two antennas. For example if the radiation is unpolarized $X_Q=X_U=X_V=0$ & $\rho=1/2$ i.e. SMMR only receives one half of the radiation from an unpolarized source. If the transmitter and SMMR polarizations are exactly matched (an unlikely event) $X_Q=S_Q$, $X_U=S_U$, $X_V=S_V$ & $\rho = 1$. If the transmitter and SMMR are linearly polarized $X_V=S_V=0$ and if the polarization directions are at an angle of Ψ to each other $\rho = (1+\mathrm{Cos}2\psi)/2 = \mathrm{Cos}^2\psi$. The power P_S received by SMMR will

result in an equivalent antenna temperature of $KTa\Delta\nu=P_S$ where K is BOLTZMANN's constant and $\Delta\nu$ is the effective RF bandpass of the SMMR receiver. Thus,

$$T_a = \left(\frac{P_{TX}}{K\Delta\nu}\right)\left(\frac{\lambda}{4\pi R}\right)^2 G_X G_S \rho$$

Example!

Assume $\rho = 1/2$. This is not critical since a rather exact polarization misalignment is required for a significant loss of signal; for example $\theta > 85°$ for $\rho < 0.01$.

Assume the transmitter radiates isotropically over the upper hemisphere:

$$\int_{2\pi}\left(\frac{P_{TRX}}{4\pi\eta}\right) G_X d\Omega = \left(\frac{P_{TRX}}{4\pi\eta}\right) G_X \int_{2\pi} d\Omega = \left(\frac{P_{TRX}}{4\pi\eta}\right) G_X 2\pi = \int_{2\pi} P_X(\theta\phi)\, d\Omega = P_{TRX}$$

and $G_X = 2\eta$.

Assume the gain of SMMR is $G_S \simeq 7(D/\lambda)^2 \simeq 10/B^2$ where λ is the wavelength of the SMMR receiver, D is the antenna diameter and B is the beamwidth in radians.

Then,

$$T_a \simeq \left(\frac{P_{TRX}}{K\Delta\nu}\right) 7 \left(\frac{D}{4\pi R}\right)^2 .$$

For D = 79cm , R = 1200Km , Δf = 250MHz ,

$$T_a \simeq 6\ P_{TRX}\ °K,$$

where P_{TRX} is in watts.

A 1/6 watt isotropic transmitter will result in a 1°K increase in antenna temperature when SMMR looks directly at it.

APPENDIX C

UNCLASSIFIED EXCERPTS FROM ORGANIZATION AND PLATFORM FILE (OPAF) LISTING

VEHICLE NOMENCLATURE TEXT VEHICLE TYPE	TENANT VEHICLE NOMENCLATURE TEXT	EQUIPMENT NOMENCLATURE TEXT		EQUIP TUNING LMTS FROM - TO	EQP QTY AUTH	SC GD SP HOL
AIMEE LYKES MARITIME WATER	292614	1450	RAY	3012-3088	1	UNC
ALLISON LYKES MARITIME WATER	293817	1450	RAY	3012-3088	1	UNC
ALMERIA LYKES MARITIME WATER	536671	CRM-N2D30	RCA	2900-3100	1	UNC
AMERICAN ACCORD MARITIME WATER	267275	CRM-N2C30	RCA	3000-3100	1	UNC
AMERICAN APOLLO MARITIME WATER	529004	CRM-N2D30	RCA	2900-3100	1	UNC
AMERICAN AQUARIUS MARITIME WATER	530999	CRM-N2D30	RCA	2900-3100	1	UNC
AMERICAN ARCHER MARITIME WATER	267444	CRM-N2C30	RCA	3000-3100	1	UNC
AMERICANARGOSY MARITIME WATER	266181	CRM-N2C30	RCA	3000-3100	1	UNC
AMERICAN CHALLENGER MARITIME WATER	289699	CRM-N2A30	RCA	2900-3100	1	UNC
AMERICAN CONDOR MARITIME WATER	252347	1450	RAY	3012-3088	1	UNC
AMERICAN FALCON MARITIME WATER	252524	1402A	RAY	3020-3120	1	UNC
AMERICAN HAWK MARITIME WATER	243969	1402	RAY	3020-3120	1	UNC
AMERICAN LEGACY MARITIME WATER	268243	CRM-N2C30	RCA	3000-3100	1	UNC
AMERICAN LEGEND MARITIME WATER	267033	CRM-N2C30	RCA	3000-3100	1	UNC
AMERICAN ORIOLE MARITIME WATER	252304	0001	RAY	3000-3246	1	UNC
AMERICAN RANGER MARITIME WATER	298270	CRM-N2B30	RCA	3000-3100	1	UNC

VEHICLE NOMENCLATURE TEXT VEHICLE TYPE	TENANT VEHICLE NOMENCLATURE TEXT	EQUIPMENT NOMENCLATURE TEXT		EQUIP TUNING LMTS FROM - TO	EQP QTY AUTH	SC GD SP HOL
AMERICAN RICE MARITIME WATER	245888	1218	RAY	3110-3120	1	UNC
AMOCO DELAWARE MARITIME WATER	245058	RM-S 0430	DEA	3040-3060	1	UNC
AMTANK MARITIME WATER	247968	1650	RAY	3020-3100	1	UNC
CV-440 CONVAIR AIR		AVQ-0010	RCA	5380-5420	1	UNC
CV-580 CONVAIR AIR		AVQ-0010	RCA	5380-5420	1	UNC
C. E. DANT MARITIME WATER	290262	CRM-N2B30	RCA	3000-3100	1	UNC
DC-006 (DOUGLAS) AIR		AVQ-0010 WP 0101	RCA COL	5380-5420 5370-5430	1	UNC
DC-006B (DOUGLAS) AIR		AVQ-0010	RCA	5380-5420	1	UNC
DC-007 (DOUGLAS) AIR		AVQ-0010 WP 0101	RCA COL	5380-5420 5370-5430	1	UNC
DC-007C SEVEN SEAS (DOUGLAS) AIR		AVQ-0010	RCA	5380-5420	1	UNC
DC-008 SERIES 10 (DOUGLAS) AIR		AVQ-0010 WP 0101	RCA COL	5380-5420 5370-5430	1 1	UNC
DC-008 SERIES 20 (DOUGLAS) AIR		AVQ-0010 RDR 0001C	RCA BEN	5380-5420 5370-5430	1 1	UNC
DC-008 SERIES 40 (DOUGLAS) AIR		AVQ-0010	RCA	5380-5420	1	UNC
DC-008 SERIES 50 (DOUGLAS) AIR		AL 101 ALA-0051 AVQ-0010 WP 0101	COL RCA COL	4250-4350 4200-4400 5380-5420 5370-5430	1 1 1 1	UNC

VEHICLE NOMENCLATURE TEXT VEHICLE TYPE	TENANT VEHICLE NOMENCLATURE TEXT	EQUIPMENT NOMENCLATURE TEXT		EQUIP TUNING LMTS FROM - TO	EQP QTY AUTH	SC SP	GD HOL
DC-008 SERIES 61F JET TRADER		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
DC-008 SERIES 61 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
DC-008 SERIES 62F JET TRADER		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051A	BEN	4200-4400	1		
DC-008 SERIES 62 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051A	BEN	4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
DC-008 SERIES 63F JET TRADER		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
DC-008 SERIES 63 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
DC-008 SERIES (DOUGLAS)		AVQ-0010	RCA	5380-5420	1		UNC
AIR							
DC-008F JET TRADER (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		AVQ-0010	RCA	5380-5420	1		
DC-009 SERIES 10 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
DC-009 SERIES 20 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR							
DC-009 SERIES 30F (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR							
DC-009 SERIES 30 (DOUGLAS)		AL 101	COL	4250-4350	1		UNC
AIR		ALA-0051		4200-4400	1		
		AVQ-0010	RCA	5380-5420	1		
REMARKS: ALSO CONTAINS (1) VAN4 DME INTERROGATOR							
DC-101 SERIES 10 (DOUGLAS)		AVQ-0030C	RCA	5370-5430	1		UNC
AIR							
REMARKS: ALSO CONTAINS (1) 618M-3 VHF TRANSCEIVER							
DC-010 SERIES 30 CF (DOUGLAS)		AVQ-0010	RCA	5380-5420	1		UNC
AIR							

SYSTEM NOMENCLATURE		TRANSMITTER TUNING RANGE MHZ	OPERATIONAL FUNCTION	EMISSION DESIGNATOR KHZ	PULSE WIDTH USEC	PULSE REP FREQ KHZ	POWER OUTPUT	HARM ATTN DB	SPUR ATTN DB	E S	J-12 NO	SEC-GDS
AL 101	COL	4250-4350	ALTIMETER	95 MF2			A .6W	-70	-70	0		U
ALA 0051		4200-4400	ALTIMETER	140 MF9			A .2W	-71	-51	0	23141	U
ALA 0051A	BEN	4200-4400	ALTIMETER	210 MF2			A .4W			0		U
AVQ-0010	RCA	5380-5420	NAVIGATION	450PO	2	.4	P 75K			0		U
AVQ 0030C	RCA	5370-5430	METRO/WX	1800PO	6	.2	P 60K	-80	-80	0		U
CRM-N2A30	RCA	2900-3100	NAVIGATION	9000PO	.1,.4	2,1	P 30K			0		U
CRM-N2B30	RCA	2900-3100	SEARCH RDR	9000PO	.1,.4	2,1	P 30K			0		U
CRM-N2C30	RCA	2900-3100	SEARCH RDR	9000PO	.1,.4	2,1	P 30K			0		U
CRM-N2D30	RCA	2900-3100	NAVIGATION	9000PO	.1,.4	2,1	P 30K			0		U
RDR 0001C	BEN	5370-5430	SEARCH RDR	450PO	2	.38-.42	P100K			0		U
RM-S 0430	DEA	3040-3060	NAVIGATION	18MPO	MULTI-VALUED		P 30K			0		U
WP 0101	COL	5370-5430	SEARCH RDR	430PO	2.1	.38-.42	P 75K			0		U
0001	RAY	3000-3246	SEARCH RDR	900PO	1	.4	P125K			0		U
1218	RAY	3110-3120	SEARCH RDR	2300PO	.4	1	P 15K			0		U
1402	RAY	3020-3120	SEARCH RDR	4500PO	.2,.6	.8,.8	P 20K			0		U
1402A	RAY	3020-3120	SEARCH RDR	6400PO	.14,.6	1.6,.8	P 20K			0		U
1450	RAY	3012-3088	NAVIGATION	7500PO	.12,.6	2.4,.8	P 20K	-60		0		U
1650	RAY	3020-3100	NAVIGATION	20MPO	.05,.4	4,1	P 60K	-60	-60	0	20551	U

APPENDIX D

EXCERPTS FROM THE INTERNATIONAL TELECOMMUNICATION UNION WORLD ADMINISTRATIVE RADIO CONFERENCE

Geneva, 1979

INTERNATIONAL TELECOMMUNICATION UNION

WORLD ADMINISTRATIVE RADIO CONFERENCE

(Geneva, 1979)

Document No. 942-E
3 December 1979

PLENARY MEETING

FINAL PROTOCOL

No. 19

Original : English

For Canada :

a) Re : Mobile satellites operating in the UHF band

In developing its mobile-satellite systems under Radio Regulation 3618/308A, Canada agrees that such systems should be coordinated and notified according to Articles N11, N13 and N13A. However, once such satellites are placed in operation, Canada considers that these systems operate with a primary status for the duration of their operational life.

b) Re : HF broadcasting

Canada considers that the problem of severe congestion of the bands allocated to the broadcasting service at HF below 9 MHz was not resolved by this Conference. A proposal by Canada for the addition of 100 kHz of spectrum between 7 300 and 7 400 kHz for this service on a world-wide basis, which would have helped to solve the problem, was rejected at the Conference by a narrow margin. For this reason, Canada reserves its right, in signing these Final Acts, to satisfy certain of its broadcasting requirements in the band segment 7 300 - 7 400 kHz. Insofar as possible, Canada, of course, will respect the rights of administrations operating in accordance with the Final Acts of this Conference.

No. 32 Original : English

For the Federal Republic of Germany, Belgium, Denmark, the United States of America, Greece, Iceland, Italy, Luxembourg, Norway, the Kingdom of the Netherlands, Portugal, the United Kingdom of Great Britain and Northern Ireland, Turkey :

The above-mentioned administrations reserve their right to operate systems in the mobile-satellite service in the frequency range 235 - 399.9 MHz under the provisions of the relevant footnote to the Table of Frequency Allocations, subject only to coordination as prescribed in Article N13A. The additional provision of this footnote imposes a condition of non-interference which could lead to a request to cease operation of a previously coordinated satellite system in the case where an administration, despite having agreed to such a satellite system, puts into service or merely plans a system that might receive harmful interference. Such a condition is unacceptable to the above administrations.

No. 36 Original : English

For the Kingdom of Saudi Arabia, the Republic of Cyprus, Spain, the United States of America, Greece, the United Kingdom of Great Britain and Northern Ireland, the Democratic Socialist Republic of Sri Lanka, the Republic of Zambia :

In the view of the above-mentioned administrations this Conference has failed to make adequate provision for the needs of the HF broadcasting service in the revised allocations, particularly at 6 and 7 MHz. Unless authority is given to the proposed HF Broadcasting Conference, by its agenda, for it to make use of some parts of the spectrum allocated to the fixed service, that Conference will not be able to plan all frequency bands to enable countries to sustain their broadcasting services in the face of varying propagation conditions throughout the solar cycle. In the absence of an adequate plan, the above-mentioned administrations reserve their right to take the necessary steps to meet the needs of their HF broadcasting services.

No. 38 Original : English

For the United States of America :

The delegation of the United States of America formally declares that the United States of America does not, by signature of these Final Acts on its behalf, accept certain decisions taken by this Conference in regard to the Table of Frequency Allocations and the associated footnotes, and therefore, the United States of America :

1. In view of the fact that this Conference has failed to provide adequate allocations for the HF broadcasting service, particularly at 6 and 7 MHz, reserves on this matter as indicated in a separate statement made jointly with the delegations of Saudi Arabia, Cyprus, Spain, Greece, the United Kingdom, Sri Lanka and Zambia;

2. Reserves the right to operate stations in the mobile satellite service in the frequency range 235 to 399.9 MHz as indicated in a separate statement made jointly with the delegations of the Federal Republic of Germany, Belgium, Denmark, Greece, Iceland, Italy, Luxembourg, Norway, the Netherlands, Portugal, the United Kingdom and Turkey;

3. In the operation of stations in the radiolocation service on a primary basis in the bands 430 - 440 MHz, 5 650 - 5 850 MHz, 8 500 - 8 750 MHz, 8 850 - 9 000 MHz, 9 200 - 9 300 MHz, 9 500 - 9 800 MHz, 10 000 - 10 500 MHz, 13.4 - 14 GHz, 15.7 - 17.3 GHz and 33.4 - 36 GHz, cannot guarantee protection to or coordination with other services;

4. Reserves the right to operate stations of the fixed, mobile and radiolocation services on a primary basis in bands as specified in the footnotes pertinent to frequency bands 470 - 806 MHz and 890 - 960 MHz, without the condition specified in these footnotes that make such operations subject to agreement under Article N13A. The United States will coordinate its usage of such services with neighbouring administrations which are affected;

5. In view of the fact that the Conference failed to provide adequate allocations for the HF maritime mobile service, particularly below 12 MHz, states its intention to satisfy maritime mobile requirements in the several HF bands below 10 MHz allocated to the mobile service on a primary basis.

No. 39 Original : English

For the United States of America :

The administration of the United States of America, calling attention to the fact that some of its broadcasting in the high frequency bands allocated to the broadcasting service are subject to willful harmful interference by administrations that are signatory to these Final Acts, and that such interference is incompatible with the rational and equitable use of these bands, declares that for as long as this interference exists, it reserves the right with respect to such interference to take necessary and appropriate actions to protect its broadcasting interests. In so doing, however, it intends to respect the rights, to the extent practicable, of administrations operating in accordance with these Final Acts.

ANNEX

RECAPITULATORY LIST OF RESERVATIONS

(IN FRENCH ALPHABETICAL ORDER)

(Figures between parentheses indicate the order in which the statements appear in the Final Protocol)

Afghanistan (Democratic Republic of) (11)

Algeria (Algerian Democratic and Popular Republic) (4)

Germany (Federal Republic of) (32) (35)

Angola (People's Republic of) (44)

Saudi Arabia (Kingdom of) (4) (36)

Argentine Republic (45)

Austria (33) (43)

Bahrain (State of) (4)

Bangladesh (People's Republic of) (4)

Belgium (5) (32)

Benin (People's Republic of) (6)

Byelorussian Soviet Socialist Republic (34)

Brazil (Federative Republic of) (29)

Canada (19)

Chile (7) (21)

China (People's Republic of) (20)

Cyprus (Republic of) (36)

Vatican City State (27)

Colombia (Republic of) (40) (41)

Congo (People's Republic of the) (40)

Korea (Republic of) (37)

Ivory Coast (Republic of the) (24)

Cuba (8) (9)

Denmark (32) (33)

United Arab Emirates (4)

Ecuador (40)

Spain (33) (36)

United States of America (32) (36) (38) (39)

Finland (33)

France (28) (33)

Gabon Republic (40)

Greece (14) (32) (36)

Guatemala (Republic of) (2)

Honduras (Republic of) (1)

India (Republic of) (22)

Indonesia (Republic of) (42)

Iran (Islamic Republic of) (4) (10) (25)

Iraq (Republic of) (4) (47)

Ireland (48)

Iceland (32)

Israel (State of) (30)

Italy (27) (32)

Japan (16)

Jordan (Hashemite Kingdom of) (4)

Kenya (Republic of) (40)

Kuwait (State of) (4)

Lebanon (4)

Libya (Socialist People's Libyan Arab Jamahiriya) (4)

Liechtenstein (Principality of) (28) (33)

Luxembourg (32)

Morocco (Kingdom of) (4)

Mauritania (Islamic Republic of) (12)

Mexico (23)

Mozambique (People's Republic of) (50)

Nigeria (Federal Republic of) (17)

Norway (32) (33)

Oman (Sultanate of) (4)

Uganda (Republic of) (40)

Pakistan (Islamic Republic of) (4) (13)

Netherlands (Kingdom of the) (32)

Portugal (27) (32) (33)

Qatar (State of) (4)

Syrian Arab Republic (4) (47)

Ukrainian Soviet Socialist Republic (34)

United Kingdom of Great Britain and Northern Ireland (32) (36) (48)

Somali Democratic Republic (4) (40)

Sudan (Democratic Republic of the) (4)

Sri Lanka (Democratic Socialist Republic of) (36)

Sweden (33)

Switzerland (Confederation of) (28) (33)

Tanzania (United Republic of) (49)

Chad (Republic of the) (3)

Tunisia (4)

Turkey (27) (31) (32)

Union of Soviet Socialist Republics (34)

Uruguay (Oriental Republic of) (15)

Venezuela (Republic of) (26)

Yemen (People's Democratic Republic of) (4) (40)

Yugoslavia (Socialist Federal Republic of) (14)

Zaire (Republic of) (18) (40)

Zambia (Republic of) (36) (51)

INTERNATIONAL TELECOMMUNICATION UNION

WORLD ADMINISTRATIVE RADIO CONFERENCE

(Geneva, 1979)

Document No. 945-E
4 December 1979 20 hrs.

PLENARY MEETING

FINAL PROTOCOL

No. 72 Original : English

For the United States of America :

With reference to statement No. 9 by the Government of the Republic of Cuba, the Government of the United States of America notes that the United States presence in Guantanamo is by virtue of a treaty in force; the United States reserves the right to meet its radiocommunication requirements there as heretofore.

No. 75 Original : English

For the Federal Republic of Germany, Australia, Austria, Belgium, Canada, Denmark, the United States of America, Finland, France, Greece, Ireland, Italy, Japan, the Principality of Liechtenstein, Luxembourg, Norway, New Zealand, Papua New Guinea, the Kingdom of the Netherlands, Portugal, the United Kingdom of Great Britain and Northern Ireland, Sweden, the Confederation of Switzerland :

The above-mentioned delegations, referring to the reservations made by the Republic of Colombia, the People's Republic of the Congo, the Republic of Ecuador, the Gabon Republic, the Republic of Kenya, the Republic of Uganda, the Somali Democratic Republic and the Republic of Zaire in statement No. 40 and by the Republic of Indonesia in statement No. 42, consider that, in as much as these statements refer to the Bogota Declaration of 3 December 1976 by equatorial countries and to the claims of those countries to exercise sovereign rights over segments of the geostationary-satellite orbit, the claims in question cannot be recognized by this Conference, and that the decisions of this Conference regarding the assignment and use of frequencies and orbital positions in the geostationary orbit are fully in accordance with the International Telecommunication Convention (Malaga-Torremolinos, 1973) by which this Conference is bound.

ARTICLE N7/5

MOD

Frequency Allocations

SUP A.N7/5 Spa2

ADD

Introduction

ADD 3414A

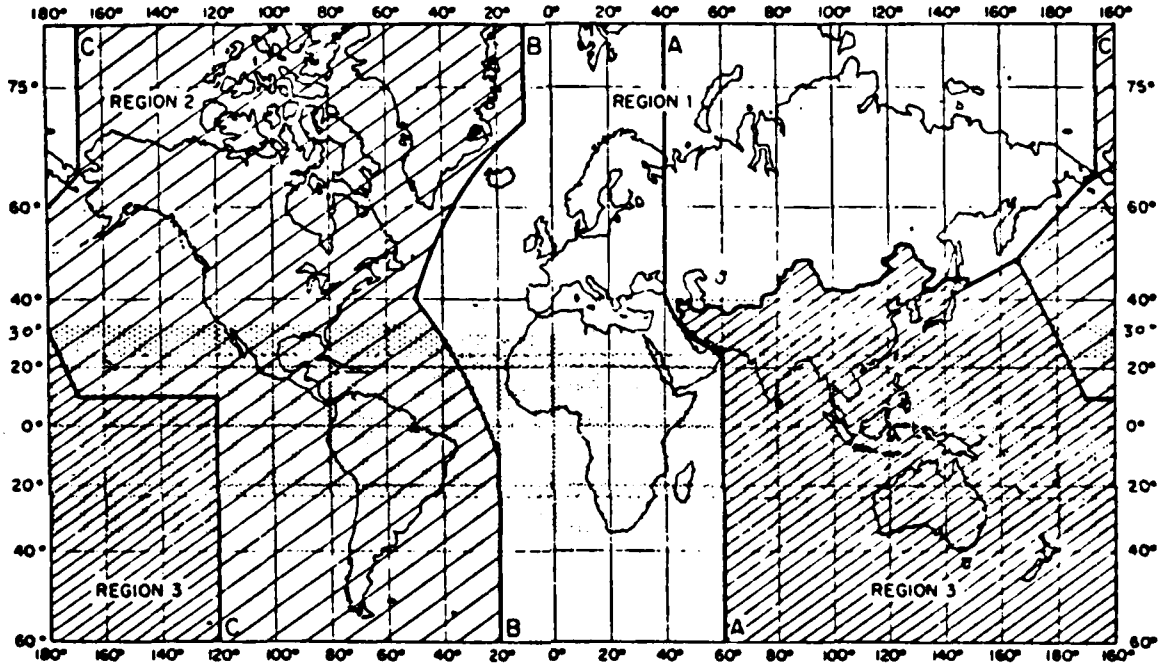
§ 0. In all documents of the Union where the terms ALLOCATION, ALLOTMENT and ASSIGNMENT are to be used, they shall have the meaning given them in Nos. 3023A to 3023C, the terms used in the three working languages being as follows:

Frequency distribution to:	French	English	Spanish
Services	Attribution (attribuer):	Allocation (to allocate)	Atribución (atribuir)
Areas or countries	Allotissement (allotir)	Allotment (to allot)	Adjudicación (adjudicar)
Stations	Assignation (assigner)	Assignment (to assign)	Asignación (asignar)

NOC

Section I. Regions and Areas

MOD 3415 125 Spa2 § 1. For the allocation of frequencies the world has been divided into three Regions [1] as shown in the following chart and described in Nos. 3416/126 to 3422/132:



The shaded part represents the Tropical Zone as defined in Nos. 3425/135 and 3426/136.

NOC 3415.1 125.1 Spa2 [1] It should be noted that where the words "regions" or "regional" are without a capital "R" in these Regulations, they do not relate to the three Regions here defined for purposes of frequency allocation.

NOC 3416 126 Region 1:

Region 1 includes the area limited on the East by line A (lines A, B and C are defined below) and on the West by line B, excluding any of the territory of Iran which lies between these limits. It also includes that part of the territory of Turkey and the Union of Soviet Socialist Republics lying outside of these limits, the territory of the Mongolian People's Republic, and the area to the North of the U.S.S.R. which lies between lines A and C.

NOC 3417 127 Region 2:

Region 2 includes the area limited on the East by line B and on the West by line C.

NOC 3418 128 Region 3:

Region 3 includes the area limited on the East by line C and on the West by line A, except the territories of the Mongolian People's Republic, Turkey, the territory of the U.S.S.R. and the area to the North of the U.S.S.R. It also includes that part of the territory of Iran lying outside of those limits.

NOC 3419 129 The lines A, B and C are defined as follows:

NOC 3420 130 Line A:

Line A extends from the North Pole along meridian 40° East of Greenwich to parallel 40° North; thence by great circle arc to the intersection of meridian 60° East and the Tropic of Cancer; thence along the meridian 60° East to the South Pole.

NOC 3421 131 Line B:

Line B extends from the North Pole along meridian 10° West of Greenwich to its intersection with parallel 72° North; thence by great circle arc to the intersection of meridian 50° West and parallel 40° North; thence by great circle arc to the intersection of meridian 20° West and parallel 10° South; thence along meridian 20° West to the South Pole.

NOC 3422 132 Line C:

Line C extends from the North Pole by great circle arc to the intersection of parallel 65° 30' North with the international boundary in Bering Strait; thence by great circle arc to the intersection of meridian 165° East of Greenwich and parallel 50° North; thence by great circle arc to the intersection of meridian 170° West and parallel 10° North; thence along parallel 10° North to its intersection with meridian 120° West; thence along meridian 120° West to the South Pole.

ADD 3422A § 1A. For the purposes of these Regulations, the term "African Broadcasting Area" means:

a) African countries, parts of countries, territories and groups of territories situated between the parallels 40° South and 30° North;

b) islands in the Indian Ocean west of meridian 60° East of Greenwich, situated between the parallel 40° South and the great circle arc joining the points 45° East, 11° 30' North and 60° East, 15° North;

c) islands in the Atlantic Ocean east of Line B defined in No. 3421/131 of these Regulations, situated between the parallels 40° South and 30° North.

MOD 3423 133 § 2. The "European Broadcasting Area" is bounded on the West by the western boundary of Region 1, on the East by the meridian 40° East of Greenwich and on the South by the parallel 30° North so as to include the western part of the U.S.S.R., the northern part of Saudi Arabia and that part of those countries bordering the Mediterranean within these limits. In addition, Iraq and Jordan are included in the European Broadcasting Area.

NOC 3424 134 The "European Maritime Area" is bounded on the North by a line extending along parallel 72° North from its intersection with meridian 55° East of Greenwich to its intersection with meridian 5° West, then along meridian 5° West to its intersection with parallel 67° North, thence along parallel 67° North to its intersection with meridian 30° West; on the West by a line extending along meridian 30° West to its intersection with parallel 30° North; on the South by a line extending along parallel 30° North to its intersection with meridian 43° East; on the East by a line extending along meridian 43° East to its intersection with parallel 60° North, thence along parallel 60° North to its intersection with meridian 55° East and thence along meridian 55° East to its intersection with parallel 72° North.

MOD 3425 135 The "Tropical Zone" (see chart in No. 3415/125) is defined as:

a) the whole of that area in Region 2 between the Tropics of Cancer and Capricorn;

b) the whole of that area in Regions 1 and 3 contained between the parallels 30° North and 35° South with the addition of:

1) the area contained between the meridian 40° East and 80° East of Greenwich and the parallels 30° North and 40° North;

2) that part of Libya north of parallel 30° North.

MHz
2 700 - 3 100

Allocation to Services		
Region 1	Region 2	Region 3
2 700 - 2 900	AERONAUTICAL RADIONAVIGATION 3676/346 Radiolocation 3727/366 3727A	
2 900 - 3 100	RADIONAVIGATION 3728/367 3729/367A 3730/367B Radiolocation 3730A	

3727 366 In the band 2 700 - 2 900 MHz ground-based radars used for meteorological purposes are authorized to operate on a basis of equality with stations of the aeronautical radionavigation service.

3727A Additional allocation : in Canada, the band 2 850 - 2 900 MHz is also allocated to the maritime radionavigation service, on a primary basis for use by shore-based radars.

3730A In the bands 2 900 - 3 100 MHz, 5 470 - 5 650 MHz and 9 200 - 9 300 MHz, the use of shipborne transponder systems shall be confined to the sub-bands 2 930 - 2 950 MHz, 5 470 - 5 480 MHz and 9 280 - 9 300 MHz.

367 The use of the band 2 900 - 3 100 MHz by the aeronautical radionavigation service is limited to ground-based radars.

367A In the bands 2 900 - 2 920 MHz and 9 300 - 9 320 MHz in the maritime radionavigation service, the use of shipborne radars other than those existing on 1 January 1976 is not permitted.

367B In the bands 2 920 - 3 100 MHz and 9 320 - 9 500 MHz in the maritime radionavigation service, the use of fixed-frequency radar beacons on land or at sea is not permitted.

MHz
3 100 - 3 300

Allocation to Services		
Region 1	Region 2	Region 3
3 100 - 3 300	RADIOLOCATION 3675A 3731/368 3732/369 3732A	

MOD 3732 369 In the band 3 100 - 3 300 MHz, radar beacons (racons) and shipborne radars on merchant ships may operate within the band 3 100 - 3 266 MHz.

MOD 3731 368 Additional allocation : in Bulgaria, Canada, Cuba Hungary, Mongolia, Poland, the German Democratic Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 3 100 - 3 300 MHz is also allocated to the radionavigation service on a primary basis.

ADD 3732A In making assignments to stations of other services, administrations are urged to take all practicable steps to protect the spectral line observations of the radio astronomy service from harmful interference in the bands 3 260 - 3 267 MHz, 3 332 - 3 339 MHz, 3 345.8 - 3 352.5 MHz and 4 825 - 4 835 MHz. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

MHz
3 300 - 3 400

Allocation to Services		
Region 1	Region 2	Region 3
3 300 - 3 400	3 300 - 3 400	3 300 - 3 400
RADIOLOCATION	RADIOLOCATION	RADIOLOCATION
	Amateur	Amateur
	Fixed	
	Mobile	
3739/376 3733/370 3732A	3733/370 3732A	3732A 3739/376

MOD 3739 376 Additional allocation : in Afghanistan, Saudi Arabia, Bahrain, Bangladesh, China, Congo, the United Arab Emirates, India, Indonesia, Iran, Iraq, Israel, Japan, Kuwait, Lebanon, Libya, Malaysia, Oman, Pakistan, Qatar, Syria, Singapore, Sri Lanka and Thailand, the band 3 300 - 3 400 MHz is also allocated to the fixed and mobile services on a primary basis. The countries bordering the Mediterranean shall not claim protection for their fixed and mobile services from the radiolocation service.

MOD 3733 370 Additional allocation : in Austria, Bulgaria, Cuba, Hungary, Mongolia, Poland, the German Democratic Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 3 300 - 3 400 MHz is also allocated to the radionavigation service on a primary basis.

SUP 3734/371

MHz
3 400 - 4 200

Allocation to Services		
Region 1	Region 2	Region 3
3 400 - 3 600 FIXED FIXED-SATELLITE (space-to-Earth) Mobile Radiolocation 3735A 3736/373 3738/375	3 400 - 3 500 FIXED FIXED-SATELLITE (space-to-Earth) Amateur Mobile Radiolocation 3736A 3644/320A 3739A	
3 600 - 4 200 FIXED FIXED-SATELLITE (space-to-Earth) Mobile	3 500 - 3 700 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile Radiolocation 3736A 3741/378	
	3 700 - 4 200 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 3742A	

ADD 3736A In Regions 2 and 3, in the band 3 400 - 3 600 MHz the radiolocation service is allocated on a primary basis. However, all administrations operating radiolocation systems in this band are urged to cease operations by 1985. Thereafter, administrations shall take all practicable steps to protect the fixed-satellite service and coordination requirements shall not be imposed on the fixed-satellite service.

ADD 3735A Different category of service : in Austria, the allocation of the band 3 400 - 3 500 MHz to the radiolocation service is on a primary basis, subject to the agreement of the administrations of the following countries : Hungary, Italy, the German Democratic Republic, Czechoslovakia and Yugoslavia. Such use is limited to ground-based stations. However, this administration is urged to cease operations by 1985. After this date this administration shall take all practicable steps to protect the fixed-satellite service and coordination requirements shall not be imposed on the fixed-satellite service.

MOD 3736 373 In Denmark, Norway and the United Kingdom, the fixed, radiolocation and fixed-satellite services operate on a basis of equality of rights in the band 3 400 - 3 600 MHz. However, these administrations operating radiolocation systems in this band are urged to cease operations by 1985. After this date these administrations shall take all practicable steps to protect the fixed-satellite service and coordination requirements shall not be imposed on the fixed-satellite service.

MOD 3738 375 Additional allocation : in the Federal Republic of Germany, Israel, Nigeria and the United Kingdom the band 3 400 - 3 475 MHz is also allocated to the amateur service on a secondary basis.

ADD 3739A Different category of service : in Indonesia, Japan, Pakistan and Thailand the allocation of the band 3 400 - 3 500 MHz to the mobile, except aeronautical mobile, service is on a primary basis (see No. 3432/141).

NOC 3741 378 In Japan, in the band 3 620 - 3 700 MHz, the radiolocation service is excluded.

ADD 3742A Additional allocation : in New Zealand, the band 3 700 - 3 770 MHz is also allocated to the radiolocation service on a secondary basis.

SUP 3735/372, 3737/374, 3740/377, 3742/379.

MHz
4 200 - 4 400

Allocation to Services		
Region 1	Region 2	Region 3
4 200 - 4 400	AERONAUTICAL RADIONAVIGATION 3743A 3743/379A 3744/381 3748/383	

ADD 3743A Use of the band 4 200 - 4 400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground. However, passive sensing in the earth exploration-satellite and space research services may be authorized in this band on a secondary basis (no protection is provided by the radio altimeters).

MOD 3748 383 Additional allocation : in the Federal Republic of Germany, Denmark, Norway and Sweden, the band 4 200 - 4 210 MHz is also allocated to the fixed service on a secondary basis.

MOD 3744 381 Additional allocation : in China, Iran, Libya, the Philippines and Sri Lanka, the band 4 200 - 4 400 MHz is also allocated to the fixed service on a secondary basis.

MOD 3743 379A The standard frequency and time signal-satellite service may be authorized to use the frequency 4 202 MHz for space-to-Earth transmissions and the frequency 6 427 MHz for Earth-to-space transmissions. Such transmissions shall be confined within the limits of ± 2 MHz of these frequencies and shall be subject to agreement obtained under the procedure set forth in Article N13A.

SUP 3745/382

MHz
4 400 - 4 990

Allocation to Services		
Region 1	Region 2	Region 3
4 400 - 4 500	FIXED MOBILE	
4 500 4 800	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3748B	
4 800 - 4 990	FIXED MOBILE 3746A Radio Astronomy 3732A 3746B 3680D	

ADD 3748B Alternative allocation : in Belgium, Norway, the Netherlands and the United Kingdom, the band 4 500 - 4 800 MHz is allocated to the fixed and mobile services on a primary basis. Such use shall not impose power flux-density limitations on the fixed-satellite service greater than those given in No. 6064/470NM.

ADD 3746A In the bands 4 825 - 4 835 MHz and 4 950 - 4 990 MHz, the allocation to the mobile service is restricted to the mobile, except aeronautical mobile, service.

ADD 3746B Different category of service : in Argentina, Australia and Canada, the allocation of the bands 4 825 - 4 835 MHz and 4 950 - 4 990 MHz to the radio astronomy service is on a primary basis. In making assignments to stations of other services to which these bands are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

SUP 3746/382A, 3747/382B, 3749/383A.

MHz
4 400 - 4 990

Allocation to Services		
Region 1	Region 2	Region 3
4 400 - 4 500	FIXED MOBILE	
4 500 4 800	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3748B	
4 800 - 4 990	FIXED MOBILE 3746A Radio Astronomy 3732A 3746B 3680D	

ADD 3748B Alternative allocation : in Belgium, Norway, the Netherlands and the United Kingdom, the band 4 500 - 4 800 MHz is allocated to the fixed and mobile services on a primary basis. Such use shall not impose power flux-density limitations on the fixed-satellite service greater than those given in No. 6064/470NM.

ADD 3746A In the bands 4 825 - 4 835 MHz and 4 950 - 4 990 MHz, the allocation to the mobile service is restricted to the mobile, except aeronautical mobile, service.

ADD 3746B Different category of service : in Argentina, Australia and Canada, the allocation of the bands 4 825 - 4 835 MHz and 4 950 - 4 990 MHz to the radio astronomy service is on a primary basis. In making assignments to stations of other services to which these bands are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

SUP 3746/382A, 3747/382B, 3749/383A.

MHz
4 990 - 5 000

Allocation to Services		
Region 1	Region 2	Region 3
4 990 - 5 000	FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY Space Research (passive) 3531L	

ADD 3531L In making assignments to stations of other services to which the band 4 990 - 5 000 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see *Nos* 3280/116 and 3281/116A and Article N33A).

MHz
5 000 - 5 470

Allocation to Services		
Region 1	Region 2	Region 3
5 000 - 5 250	AERONAUTICAL RADIONAVIGATION 3687/352B 3750/383B 3750AA	
5 250 - 5 255	RADIOLOCATION Space Research 3751/384 3675A	
5 255 - 5 350	RADIOLOCATION 3751/384 3675A	
5 350 - 5 460	AERONAUTICAL RADIONAVIGATION 3753/385 Radiolocation	
5 460 - 5 470	RADIONAVIGATION 3753/385 Radiolocation	

MOD 3750 383B The bands 5 000 - 5 250 MHz, and 15.4 - 15.7 GHz are also allocated to the fixed-satellite service and the inter-satellite service, for connection between one or more earth stations at specified fixed points on the Earth and space stations, when these services are used in conjunction with the aeronautical radionavigation and/or aeronautical mobile (R) service. Such use shall be subject to agreement obtained under the procedure set forth in Article N13A.

ADD 3750AA The band 5 000 - 5 250 MHz is to be used for the operation of the international standard system (microwave landing system) for precision approach and landing. The requirements of this system shall take precedence over other uses of this band.

MOD 3751 384 Additional allocation : in Austria, Bulgaria, Hungary, Libya, Mongolia, Poland, the German Democratic Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 5 250 - 5 350 MHz is also allocated to the radionavigation service on a primary basis.

NOC 3753 385 The use of the band 5 350 - 5 470 MHz by the aeronautical radionavigation service is limited to airborne radars and associated airborne beacons.

SUP 3752/384A

MHz
5 470 - 5 650

Allocation to Services		
Region 1	Region 2	Region 3
5 470 - 5 650	MARITIME RADIONAVIGATION Radiolocation 3754/386 3755/387 3730A 3755A	

MOD 3754 386 Additional allocation : in Afghanistan, Austria, Bulgaria, Hungary, Iran, Mongolia, Poland, the German Democratic Republic, Roumania, Czechoslovakia and the U.S.S.R., the band 5 470 - 5 650 MHz is also allocated to the aeronautical radionavigation service on a primary basis.

ADD 3755A Additional allocation : in the United Kingdom, the band 5 470 - 5 850 MHz is also allocated to the land mobile service on a secondary basis. The power limits specified in Nos. 6002/470AA, 6005/470B, 6006/470BA and 6007/470C shall apply in the band 5 725 - 5 850 MHz.

NOC 3755 387 Between 5 600 - 5 650 MHz, ground-based radars used for meteorological purposes are authorized to operate on a basis of equality with stations of the maritime radionavigation service.

MHz
5 650 - 5 725

Allocation to Services		
Region 1	Region 2	Region 3
5 650 - 5 725	RADIOLOCATION Amateur Space Research (deep space) 3757/389 3755A 3644/320A 3758/389A 3758A	

MOD 3757 389 Additional allocation : in Afghanistan, Saudi Arabia, Bahrain, Bangladesh, Cameroon, Central African Republic, China, Congo, Korea (Republic of), Egypt, the United Arab Emirates, Gabon, Guinea, India, Indonesia, Iran, Iraq, Israel, Japan, Jordan, Kuwait, Lebanon, Libya, Madagascar, Malaysia, Malawi, Malta, Niger, Nigeria, Pakistan, the Philippines, Qatar, Syria, Singapore, Sri Lanka, Tanzania, Chad, Thailand and Yemen (P.D.R. of) the band 5 650 - 5850 MHz is also allocated to the fixed and mobile services on a primary basis.

MOD 3758 389A Different category of service : in Bulgaria, Cuba, Hungary, Mongolia, Poland, the German Democratic Republic, Czechoslovakia and the U.S.S.R., the allocation of the band 5 670 - 5 725 MHz to the space research service is on a primary basis (see No. 3432/141).

ADD 3758A Additional allocation : in Bulgaria, Cuba, Hungary, Mongolia, Poland, the German Democratic Republic, Czechoslovakia and the U.S.S.R., the band 5 670 - 5 850 MHz is also allocated to the fixed service on a primary basis.

MHz
5 725 - 5 925

Allocation to Services		
Region 1	Region 2	Region 3
5 725 - 5 850 FIXED-SATELLITE (Earth-to-space) RADIOLOCATION Amateur 3756/388 3760/391 3755A 3758A 3757/389 3761C	5 725 - 5 850 RADIOLOCATION Amateur 3757/389 3760/391 3758A 3761C	
5 850 - 5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 3760/391	5 850 - 5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Amateur Radiolocation 3760/391	5 850 - 5 925 FIXED FIXED-SATELLITE (Earth-to-space) MOBILE Radiolocation 3760/391

MOD 3760 391 The band 5 725 - 5 875 MHz (centre frequency 5 800 MHz) is designated for industrial, scientific and medical (ISM) applications. Radiocommunication services operating within this band must accept harmful interference which may be caused by these applications. ISM equipment operating in this band is subject to the provisions of No. 5002A.

MOD 3756 388 Additional allocation : in the Federal Republic of Germany, the band 5 755 - 5 850 MHz is also allocated to the fixed service on a primary basis.

ADD 3761C The band 5 830 - 5 850 MHz is also allocated to the amateur-satellite service (space-to-Earth) on a secondary basis.

SUP 3759/390

GHz
15.7 - 17.7

Allocation to Services		
Region 1	Region 2	Region 3
15.7 - 16.6	RADIOLOCATION 3794F 3794FA	
16.6 - 17.1	RADIOLOCATION Space Research (deep space) (Earth-to-space) 3794F 3794FA	
17.1 - 17.2	RADIOLOCATION 3794F 3794FA	
17.2 - 17.3	RADIOLOCATION Earth Exploration-Satellite (active) Space Research (active) 3794F 3794FA	
17.3 - 17.7	FIXED-SATELLITE (Earth-to-space) 3794H Radiolocation 3794G	

ADD 3794F Additional allocation : in Afghanistan, Algeria, Angola, Saudi Arabia, Austria, Bahrain, Bangladesh, Cameroon, Costa Rica, Egypt, El Salvador, the United Arab Emirates, Finland, Guatemala, India, Indonesia, Iran, Kuwait, Libya, Malaysia, Malawi, Malta, Morocco, Mozambique, Nepal, Nicaragua, Oman, Pakistan, Qatar, Singapore, Somalia, Sudan, Sri Lanka, Sweden, Tanzania, Chad, Thailand, Yemen (P.D.R.) and Yugoslavia, the band 15.7 - 17.3 GHz is also allocated to the fixed and mobile services on a primary basis.

ADD 3794FA Additional allocation : in Israel, the band 15.7 - 17.3 GHz is also allocated to the fixed and mobile services on a primary basis. These services shall not claim protection from, or cause harmful interference to services operating in accordance with the Table in countries other than those included in 3794F.

ADD 3794G Additional allocation : in Afghanistan, Algeria, the Federal Republic of Germany, Angola, Saudi Arabia, Austria, Bahrain, Bangladesh, Cameroon, Honduras, Costa Rica, El Salvador, the United Arab Emirates, Finland, Guatemala, India, Indonesia, Iran, Iraq, Israel, Japan, Kuwait, Libya, Nepal, Nicaragua, Pakistan, Qatar, Sudan, Sri Lanka, Sweden, Thailand and Yugoslavia, the band 17.3 - 17.7 GHz is also allocated to the fixed and mobile services on a secondary basis. The power limits given in Nos. 6005/4708 and 6008/4708A shall apply provisionally (see Resolution BQ).

ADD 3794H The use of the band 17.3 - 18.1 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service.

GHz
10.7 - 11.7

Allocation to Services		
Region 1	Region 2	Region 3
10.7 - 11.7 FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 3784A MOBILE except aeronautical mobile	10.7 - 11.7 FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile	

ADD 3784A In Region 1, the use of the band 10.7 - 11.7 GHz by the fixed-satellite service (Earth-to-space) is limited to feeder links for the broadcasting-satellite service.

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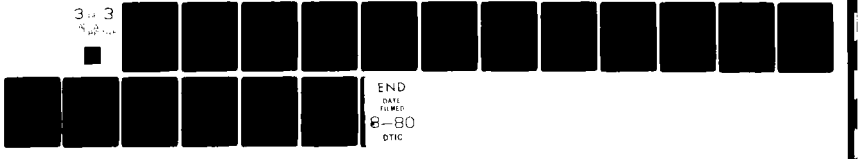

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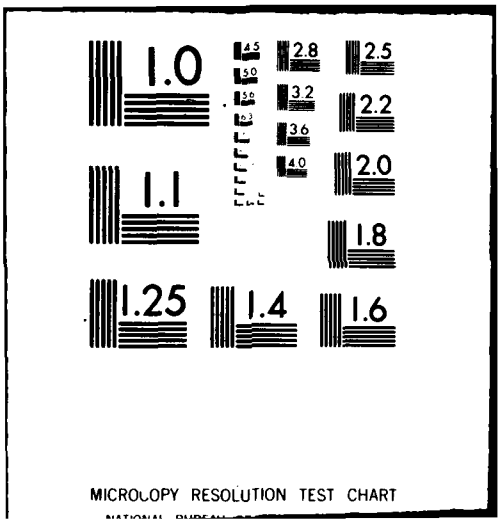
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5.0
5.6
MICROCOPY RESOLUTION TEST CHART

GHz
10.6 - 10.7

Allocation to Services		
Region 1	Region 2	Region 3
10.6 - 10.68	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY SPACE RESEARCH (passive) Radiolocation 3531A 3783B	
10.68 - 10.7	EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 3784/405B 3784B	

ADD 3531A In making assignments to stations of other services to which the band 10.6 - 10.68 GHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

ADD 3783B In the band 10.6 - 10.68 GHz, the fixed and mobile, except aeronautical mobile, services shall be limited to a maximum equivalent isotropically radiated power of 40 dBW and the power delivered to the antenna shall not exceed -3 dBW. These limits may be exceeded subject to agreement obtained under the procedure set forth in Article N13A. However in Afghanistan, Saudi Arabia, Bahrain, Bangladesh, China, the United Arab Emirates, Finland, India, Indonesia, Iran, Iraq, Japan, Kuwait, Lebanon, Nigeria, Pakistan, the Philippines, Qatar, Syria and the U.S.S.R., the restrictions on the fixed and mobile, except aeronautical mobile, services are not applicable.

ADD 3784B All emissions in the band 10.68 - 10.7 GHz are prohibited, except for those provided for by No. 3784/405B.

MOD 3784 405B Additional allocation : in Saudi Arabia, Bahrain, Bulgaria, Cameroon, China, Colombia, Korea (Republic of), Costa Rica, Cuba, Egypt, the United Arab Emirates, Ecuador, Hungary, Iran, Iraq, Israel, Japan, Kuwait, Lebanon, Mongolia, Pakistan, Poland, Qatar, the German Democratic Republic, Roumania, Czechoslovakia, the U.S.S.R. and Yugoslavia, the band 10.6 - 10.7 GHz is also allocated to the fixed and mobile, except aeronautical mobile, service on a primary basis. Such use is limited to equipment in operation by 1 January 1985.

SUP 3783, 3784A

GHz
10 - 10.6

Allocation to Services		
Region 1	Region 2	Region 3
10 - 10.45 FIXED MOBILE RADIOLOCATION Amateur 3779/401A	10 - 10.45 RADIOLOCATION Amateur 3779/401A 3780/402	10 - 10.45 FIXED MOBILE RADIOLOCATION Amateur 3779/401A
10.45 - 10.5	RADIOLOCATION Amateur Amateur-Satellite 3780A	
10.5 - 10.55 FIXED MOBILE Radiolocation	10.5 - 10.55 FIXED MOBILE RADIOLOCATION	
10.55 - 10.6	FIXED MOBILE except aeronautical mobile Radiolocation	

MOD 3780 402 Additional allocation : in Costa Rica, Ecuador, Guatemala, and Honduras, the band 10 - 10.45 GHz is also allocated to the fixed and mobile services on a primary basis.

ADD 3780A Additional allocation : in the Federal Republic of Germany, Angola, China, Ecuador, Spain, Japan, Kenya, Morocco, Nigeria, Sweden, Tanzania and Thailand, the band 10.45 - 10.5 GHz is also allocated to the fixed and mobile services on a primary basis.

SUP 3781/403 3782/404

MHz
7 250 - 7 550

Allocation to Services		
Region 1	Region 2	Region 3
7 250 - 7 300	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3764B	
7 300 - 7 450	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile 3764B	
7 450 - 7 550	FIXED FIXED-SATELLITE (space-to-Earth) METEOROLOGICAL-SATELLITE (space-to-Earth) MOBILE except aeronautical mobile	

ADD 3764B The bands 7 250 7 375 MHz (space-to-Earth) and 7 900 - 8 025 MHz (Earth-to-space) may also be used by the mobile-satellite service. The use of these bands by this service shall be subject to agreement obtained under the procedure set forth in Article N13A.

SUP 3764/392D, 3765/392G

MHz
5 925 - 7 250

Allocation to Services		
Region 1	Region 2	Region 3
5 925 - 7 075	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE 3743/379A 3761B	
7 075 - 7 250	FIXED MOBILE 3763/392B 3761B 3762A	

ADD 3761B In the band 6 425 - 7 075 MHz, passive microwave sensor measurements are carried out over the oceans. In the band 7 075 - 7 250 MHz, passive microwave sensor measurements are carried out. Administrations should bear in mind the needs of the earth exploration-satellite (passive) and space research (passive) services in their future planning of this band.

ADD 3762A Subject to agreement obtained under the procedure set forth in Article N13A, in Region 2, the band 7 125 - 7 155 MHz may be used for Earth-to-space transmissions in the space operation service.

MOD 3763 392B Subject to agreement obtained under the procedure set forth in Article N13A, the band 7 145 - 7 235 MHz may be used for Earth-to-space transmissions in the space research service. The use of the band 7 145 - 7 190 MHz is restricted to deep space; no emissions to deep space shall be effected in the band 7 190 - 7 235 MHz.

SUP 3762/392AA, 3767/393

GHz
13.25 - 14

Allocation to Services		
Region 1	Region 2	Region 3
13.25 - 13.4	AERONAUTICAL RADIONAVIGATION 3791/406 3793/407A 3793A	
13.4 - 14	RADIOLOCATION Standard Frequency and Time Signal-Satellite (Earth-to-space) Space Research 3675A 3793A 3794D 3798/409	

MOD 3791 406 The use of the band 13.25 - 13.4 GHz by the aeronautical radionavigation service is limited to Doppler navigation aids.

MOD 3793 407A Subject to agreement obtained under the procedure set forth in Article N13A, the band 13.25 - 13.4 GHz may also be used in the space research service (Earth-to-space) on a secondary basis.

ADD 3793A Additional allocation : in Bangladesh, India and Pakistan, the band 13.25 - 14 GHz is also allocated to the fixed service on a primary basis.

ADD 3794D Additional allocation : in Afghanistan, Algeria, Angola, Saudi Arabia, Bahrain, Cameroon, Korea (Republic of), Egypt, the United Arab Emirates, Finland, Gabon, Guinea, Indonesia, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Madagascar, Malaysia, Malawi, Mali, Malta, Morocco, Mauritania, Niger, Nigeria, Pakistan, Qatar, Syria, Senegal, Singapore, Sri Lanka, Sudan, Sweden, Chad, Thailand and Tunisia, the band 13.4 - 14 GHz is also allocated to the fixed and mobile services on a primary basis.

MOD 3798 409 Additional allocation : in Austria, Bulgaria, Hungary, Japan, Mongolia, Poland, the German Democratic Republic, Roumania, the United Kingdom, Czechoslovakia and the U.S.S.R., the band 13.4 - 14 GHz is also allocated to the radionavigation service on a primary basis.

SUP 3792 407

GHz
14 - 14.25

Allocation to Services		
Region 1	Region 2	Region 3
14 - 14.25	FIXED-SATELLITE (Earth-to-space) 3793B RADIONAVIGATION 3795/408A Space Research 3795C 3794B	

ADD 3794B The band 14 - 14.5 GHz is also allocated to the land mobile-satellite service (Earth-to-space) on a secondary basis.

MOD 3795 408A The use of the band 14 - 14.3 GHz by the radionavigation service shall be such as to provide sufficient protection to space stations of the fixed-satellite service (see Recommendation ZQ).

ADD 3795C Additional allocation : in Afghanistan, Algeria, Angola, Saudi Arabia, Australia, Bahrain, Bangladesh, Botswana, Cameroon, China,. Korea (Republic of), Egypt, the United Arab Emirates, Gabon, Guatemala, Guinea, India, Indonesia, Iran, Iraq, Israel, Japan, Kenya, Kuwait, Lesotho, Lebanon, Malaysia, Malawi, Mali, Malta, Morocco, Mauritania, Niger, Pakistan, the Philippines, Qatar, Syria, Senegal, Singapore, Somalia, Sudan, Sri Lanka, Swaziland, Tanzania, Chad, Thailand and Yemen (P.D.R.), the band 14 - 14.3 GHz is also allocated to the fixed service on a primary basis.

ADD 3793B The band 14 - 14.5 GHz may be used, within the fixed-satellite service (Earth-to-space), for feeder links for the broadcasting-satellite service, subject to coordination with other networks in the fixed-satellite service. Such use for feeder links is reserved for countries outside Europe and for Malta.

GHz
14.5 - 15.35

Allocation to Services		
Region 1	Region 2	Region 3
14.5 - 14.8	FIXED FIXED-SATELLITE (Earth-to-space) 3796A MOBILE Space Research	
14.8 - 15.35	FIXED MOBILE Space Research 3680D	

ADD 3796A The use of the band 14.5 - 14.8 GHz by the fixed-satellite service is limited to feeder links for the broadcasting-satellite service. This use is reserved for countries outside Europe and for Malta.

GHz
17.7 - 19.7

Allocation to Services		
Region 1	Region 2	Region 3
17.7 - 18.1	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space) 3794H MOBILE	
18.1 - 18.6	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3799A	
18.6 - 18.8 FIXED FIXED-SATELLITE (space-to-Earth) 3800B MOBILE except aeronautical mobile Earth-Exploration-Satellite (passive) Space Research (passive) 3800A	18.6 - 18.8 EARTH EXPLORATION-SATELLITE (passive) FIXED FIXED-SATELLITE (space-to-Earth) 3800B MOBILE except aeronautical mobile SPACE RESEARCH (passive) 3800A	18.6 - 18.8 FIXED FIXED-SATELLITE (space-to-Earth) 3800B MOBILE except aeronautical mobile Earth Exploration-Satellite (passive) Space Research (passive) 3800A
18.8 - 19.7	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE	

ADD 3799A **The band 18.1 - 18.3 GHz is also allocated to the meteorological-satellite service (space-to-Earth) on a primary basis. Its use is limited to geostationary satellites and shall be in accordance with the provisions of No. 6076/470NY.**

ADD 3800A **In making assignments to stations in the fixed and mobile services, administrations are invited to take account of passive sensors in the earth-exploration satellite and space research services operating in the band 18.6 - 18.8 GHz. In this band, administrations should endeavor to limit as far as possible both the power delivered by the transmitter to the antenna and the e.i.r.p. in order to reduce the risk of interference to passive sensors to the minimum.**

ADD 3800B **In assigning frequencies to stations in the fixed-satellite service in the direction space-to-Earth, administrations are requested to limit as far as practicable the power flux-density at the Earth's surface in the band 18.6 - 18.8 GHz, in order to reduce the risk of interference to passive sensors in the earth exploration-satellite and space research services.**

GHz
19.7 - 22

Allocation to Services		
Region 1	Region 2	Region 3
19.7 - 20.2	FIXED-SATELLITE (space-to-Earth) Mobile-satellite (space-to-Earth) 3800M	
20.2 - 21.2	FIXED-SATELLITE (space-to-Earth) MOBILE-SATELLITE (space-to-Earth) Standard Frequency and Time Signal-Satellite (space-to-Earth) 3800M	
21.2 - 21.4	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE SPACE RESEARCH (passive)	
21.4 - 22	FIXED MOBILE	

ADD 3800M **Additional allocation : in Afghanistan, Algeria, Angola, Saudi Arabia, Bahrain, Bangladesh, Brazil, Cameroon, China, Congo, Korea (Republic of), Costa Rica, Egypt, the United Arab Emirates, Gabon, Guatemala, Guinea, India, Indonesia, Iran, Iraq, Israel, Japan, Kenya, Kuwait, Malaysia, Mali, Morocco, Mauritania, Nepal, Niger, Nigeria, Pakistan, the Philippines, Qatar, Syria, Singapore, Somalia, Sudan, Sri Lanka, Tanzania, Chad, Thailand, Togo, Tunisia and Zaire the band 19.7 - 21.2 GHz is also allocated to the fixed and mobile services on a primary basis. This additional use shall not impose any limitation on the power flux-density of space stations in the fixed-satellite service.**

GHz
22 - 22.5

Allocation to Services		
Region 1	Region 2	Region 3
22 - 22.21	FIXED MOBILE except aeronautical mobile 3801A	
22.21 - 22.5	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE except aeronautical mobile RADIO ASTRONOMY SPACE RESEARCH (passive) 3801B 3801BA	

ADD 3801A In making assignments to stations of other services, administrations are urged to take all practicable steps to protect the spectral line observations of the radio astronomy service in the band 22.01 - 22.21 GHz from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see also No. 3280/116 and 3281/116A and Article N33A).

ADD 3801B In making assignments to stations of other services, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference in the band 22.21 - 22.5 GHz. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see also No. 3280/116 and 3281/116A and Article N33A).

ADD 3801BA The use of the band 22.21 - 22.5 GHz by the earth exploration-satellite (passive) and space research (passive) services shall not impose constraints upon the fixed and mobile, except aeronautical mobile services.

SUP 3801 410A

GHz
22.5 - 23.6

Allocation to Services		
Region 1	Region 2	Region 3
22.5 - 22.55 FIXED MOBILE	22.5 - 22.55 BROADCASTING-SATELLITE 3802/410B FIXED MOBILE 3801C	
22.55 - 23 FIXED INTER-SATELLITE MOBILE 3801D	22.55 - 23 BROADCASTING-SATELLITE 3802/410B FIXED INTER-SATELLITE MOBILE 3801C 3801D	
23 - 23.55	FIXED INTER-SATELLITE MOBILE 3801D	
23.55 - 23.6	FIXED MOBILE	

MOD 3802-410B **In Regions 2 and 3, the broadcasting-satellite service is authorized in the band 22.5 - 23.0 GHz, subject to agreement obtained under the procedure set forth in Article N13A.**

ADD 3801C **Additional allocation: in Japan, the band 22.5 - 23 GHz is also allocated to the broadcasting service on a primary basis.**

ADD 3801D **In making assignments to stations of other services, administrations are urged to take all practicable steps to protect the spectral line observations of the radio astronomy service in the bands 22.81 - 22.86 GHz and 23.07 - 23.12 GHz from harmful interference. Emissions from space or aircraft stations can be particularly serious sources of interference to the radio astronomy service (see also No. 3280/116 and 3281/116A and Article M33A.)**

GHz
34.2 - 36

Allocation to Services		
Region 1	Region 2	Region 3
34.2 - 35.2	RADIOLOCATION Space Research 3808/412C 3808A 3794/408	
35.2 - 36	METEOROLOGICAL AIDS RADIOLOCATION 3799B 3794/408	

MOD 3808 412C Different category of service : in Bulgaria, Cuba, Hungary, Poland, Mongolia, the German Democratic Republic, Czechoslovakia and the U.S.S.R, the allocation of the band 34.2 - 35.2 GHz to the space research service is on a primary basis (see No. 3432/141).

ADD 3808A Different category of service ; in Australia, Spain and the United States, the allocation of the band 34.2 - 34.7 GHz to the space research (deep space) (Earth-to-space) service is on a primary basis (see No. 3432/141).

ADD 3799B Radars located on spacecraft may be operated on a primary basis in the band 35.5 - 35.6 GHz.

SUP 3809/412D

GHz
36 - 40.5

Allocation to Services		
Region 1	Region 2	Region 3
36 - 37	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE SPACE RESEARCH (passive) 3761/391A	
37 - 37.5	FIXED MOBILE 3807C	
37.5 - 39.5	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3807C	
39.5 - 40.5	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth)	

MOD 3761 391A In making assignments to stations of other services, administrations are urged to take all practicable steps to protect the spectral line observations of the radio astronomy service in the band 36.43 - 36.5 GHz from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

ADD 3807C Subject to agreement obtained under the procedure set forth in Article N13A, the band 37 - 39 GHz may also be used in Japan for Earth-to-space transmissions in the fixed-satellite service up to 31 December 1990.

SUP 3810/412E

GHz
40.5 - 43.5

Allocation to Services		
Region 1	Region 2	Region 3
40.5 - 42.5	BROADCASTING-SATELLITE /BROADCASTING/ Fixed Mobile	
42.5 - 43.5	FIXED FIXED-SATELLITE (Earth-to-space) 3814B MOBILE except aeronautical mobile RADIO ASTRONOMY 3814A	

ADD 3814A In making assignments to stations of other services to which the band 42.5 - 43.5 GHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference, especially in the bands 42.77 - 42.87 GHz, 43.07 - 43.17 GHz, and 43.37 - 43.47 GHz, which are used for spectral line observations of silicon monoxide. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A.)

ADD 3814B The allocation of the spectrum for the fixed-satellite service in the bands 42.5 - 43.5 GHz and 47.2 - 50.2 GHz for Earth-to-space transmission is greater than that in the band 37.5 - 39.5 GHz for space-to-Earth transmission in order to accommodate feeder links to broadcasting satellites. Administrations are urged to take all practicable steps to reserve the band 47.2 - 49.2 GHz for feeder links to broadcasting satellites operating in the band 40.5 - 42.5 GHz.

GHz
43.5 - 50.2

Allocation to Services		
Region 1	Region 2	Region 3
43.5 - 47	**MOBILE** 3814CA **MOBILE-SATELLITE** **RADIONAVIGATION** **RADIONAVIGATION-SATELLITE** 3814C	
47 - 47.2	**AMATEUR** **AMATEUR-SATELLITE**	
47.2 - 50.2	**FIXED** **FIXED-SATELLITE (Earth-to-space)** 3814B **MOBILE** 3814E 3814D	

ADD 3814C In the bands 43.5 - 47 GHz, 66 - 71 GHz, 95 - 100 GHz, 134 - 142 GHz, 190 - 200 GHz and 252 - 265 GHz, satellite links connecting land stations at specified fixed points are also authorized when used in conjunction with the mobile-satellite service or the radionavigation-satellite service.

ADD 3814CA In the bands 43.5 - 47 GHz, 66 - 71 GHz, 95 - 100 GHz, 134 - 142 GHz, 190 - 200 GHz and 252 - 265 GHz, stations in the land mobile service may be operated subject to not causing harmful interference to the space radiocommunication services to which these bands are allocated (see No. 3442/148).

ADD 3814D The bands 48.94 - 49.04 GHz, and 97.88 - 98.08 GHz are also allocated to the radio astronomy service on a primary basis for spectral line observations. In making assignments to stations of other services to which these bands are allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A.)

ADD 3814E In the band 48.94 - 49.04 GHz, all emissions from airborne stations are prohibited.

GHz
76 - 86

Allocation to Services		
Region 1	Region 2	Region 3
76 - 81	RADIOLOCATION Amateur Amateur-satellite 3815E	
81 - 84	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE MOBILE-SATELLITE (space-to-Earth)	
84 - 86	FIXED MOBILE BROADCASTING BROADCASTING-SATELLITE 3815F	

ADD 3815E In the band 78 - 79 GHz radars located on space stations may be operated on a primary basis in the earth exploration-satellite service and in the space research service.

ADD 3815F In the band 84 - 86 GHz, stations in the fixed, mobile and broadcasting services shall not cause harmful interference to broadcasting-satellite stations operating in accordance with the decisions of the appropriate frequency assignment planning conference for the broadcasting-satellite service.

GHz
86 - 95

Allocation to Services		
Region 1	Region 2	Region 3
86 - 92	EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 3815/412J	
92 - 95	FIXED FIXED-SATELLITE (Earth-to-space) MOBILE RADIOLOCATION 3815G	

ADD 3815G The band 93.07 - 93.27 GHz is also used by the radio astronomy service for spectral line observations. In making assignments to stations of the services to which this band is allocated, administrations are urged to take all practicable steps to protect radio astronomy observations from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. 3280/116 and 3281/116A and Article N33A).

GHz
95 - 116

Allocation to Services		
Region 1	Region 2	Region 3
95 - 100	MOBILE 3814CA MOBILE-SATELLITE RADIONAVIGATION RADIONAVIGATION-SATELLITE Radiolocation 3814C 3814D	
100 - 102	EARTH EXPLORATION-SATELLITE (passive) FIXED MOBILE SPACE RESEARCH (passive) 3679A	
102 - 105	FIXED FIXED-SATELLITE (space-to-Earth) MOBILE 3679A	
105 - 116	EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 3679A 3815/412J	

SUP 3816/412K
Spa2